NAVAL WEAPONS STATION
CONCORD EXPORT CAPABILITY
A SIMULATION MODEL.

David C. Fountain

NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

NAVAL WEAPONS STATION, CONCORD
EXPORT CAPABILITY:
A SIMULATION MODEL

by

David C. Fountain

June 1977

Thesis Advisor: Robert W. Sagehorn

Approved for public release; distribution unlimited

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) NAVAL WEAPONS STATION, CONCORD EXPORT CAPABILITY: A SIMULATION MODEL		5. TYPE OF REPORT & PERIOD COVERED Master's Thesis June 1977
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) David C. Fountain		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940		12. REPORT DATE June 1977
		13. NUMBER OF PAGES 143
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Naval Postgraduate School Monterey, California 93940		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Simulation, Water ports, Transportation, Export capability, Ammunition, TRANSIM

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This paper represents an analysis of the ocean ammunition export function of the Naval Weapons Station at Concord, California. The analysis, utilizing the general purpose transportation simulator TRANSIM, defines the system and adapts it to TRANSIM notation. The objective of the project was to establish a workable model and use it to predict the maximum export capability of NWS, Concord. Five simulations were

completed; three replicated the historical data to establish the model's workability and the other two indicated increased capabilities possible.

NAVAL WEAPONS STATION, CONCORD EXPORT CAPABILITY: A SIMULATION MODEL

by

David C. Fountain
Captain, United States Army
B. S., University of Washington, 1967

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL

June 1977

ABSTRACT

This paper represents an analysis of the ocean ammunition export function of the Naval Weapons Station at Concord, California. The analysis, utilizing the general purpose transportation simulator TRANSIM, defines the system and adapts it to TRANSIM notation. The objective of the project was to establish a workable model and use it to predict the maximum export capability of NWS, Concord. Five simulations were completed; three replicated the historical data to establish the model's workability and the other two indicated increased capabilities possible.

TABLE OF CONTENTS

LIST OF FIGURES

I. BACKGROUND

The Naval Weapons Station (NWS), Concord is located in California about thirty-five miles northeast of San Francisco and seventy miles southwest of Sacramento. Although the station comprises three activities at sites near Concord, Pittsburg, and Vallejo, this study concerned itself with only the Concord activity.

Of the many missions assigned to NWS, Concord, only two have relevance to this study. The two missions that related directly to the export capability are the following:

> 1. Operate a munitions storage, maintenance and transshipment facility to support the operating forces:
>
> A. Receive, renovate, maintain, store, and issue ammunition explosives, expendable ordnance items and/or weapons and technical ordnance material.
>
> B. Operate and maintain an ocean terminal facility to transship ordnance material in support of the Armed Forces...
>
> 2. Provide logistics and port terminal services in support of Pacific Fleet Ammunition Ships (AEs) homeported at the Station... [1-1].

Although NWS, Concord is a Navy owned and operated installation, by its rather unique position as the only major West Coast ammunition ocean terminal, it is required to support the other services and is thereby critical to the Department of Defense. The facility is strictly Naval but it does report for administration and accounting purposes to the Oakland Terminal of the Military Traffic Management Command, the Department of Defense agency responsible for worldwide traffic management. NWS, Concord is the ammunition counterpart of Oakland, the primary West Coast

general cargo port. (The Oakland facility is about twenty-five miles southwest of Concord.)

The facility at Concord is divided into the Inland Area and the Tidal Area. The Inland Area is concerned with research, administration, military housing, and similar activities, while the Tidal Area is concerned with the operational aspects of the transshipment of ammunition.

II. INTRODUCTION

The analysis of NWS, Concord's capabilities was accomplished by using as a basis the simulation model TRANSIM. TRANSIM is a general purpose transportation system simulator developed originally in 1966 by the Department of Engineering, University of California at Los Angeles (UCLA) for the Undersecretary of Transportation in the U.S. Department of Commerce. The continuing effort of the Project TRANSIM office at UCLA is to update and simplify the program, most recently published as TRANSIM IV.

TRANSIM is a modular approach to a transportation system model which can be utilized to model transportation networks, transfer facilities, and intermodal relationships including a marine/port complex. It is capable of utilizing either deterministic or probabilistic input data. Specific elements of TRANSIM as it applies to NWS, Concord are discussed in Chapter Six.

The input of ammunition was by two modes, truck and rail, and is recognized when the truck or the rail car "passes through the gate" and becomes available for handling by NWS, Concord. The ammunition is inspected, catalogued, and placed in storage until required for loading aboard a vessel. Empty vessels (partially loaded vessels from other ports were considered empty vessels throughout the analysis) enter the system through a harbor, and exit to the harbor after loading. A general schematic of the system elements is shown in Figure 1.

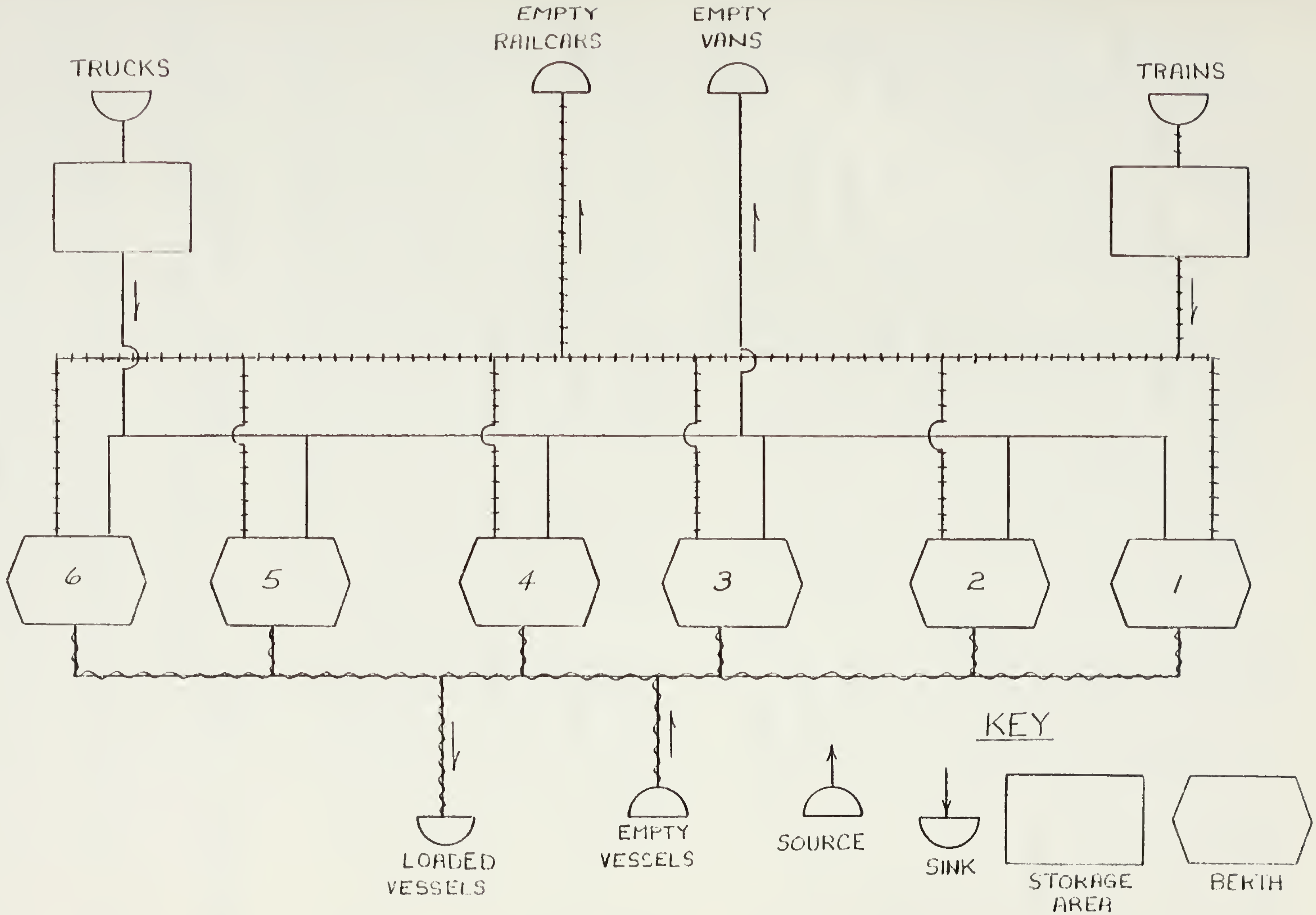

Figure 1 - GENERALIZED SYSTEM

The study considered only the export of ammunition aboard merchant marine type cargo vessels and did not provide for the handling of any waterborne imported cargo. This specifically excluded ship discharge operations and operations of the U. S. Navy vessels commonly referred to as AEs, which were found to be low productive factors in the historical data. Since the AEs are homeported at Concord, this restriction may not have been completely realistic. Therefore, toward the end of the analysis consideration was given to the probable presence and needs of AEs, and these vessels are discussed as a part of the system in Chapter Eight. However, to achieve the maximum export capability of NWS, Concord, the AEs were considered a negative influence, as will be explained later, and were excluded in the building of the model.

The study was restricted in one notable area. All computer simulations were processed with the computer at UCLA, where the most current version of TRANSIM is stored on tape. The complexity of the program did not allow for the program to be transferred to another computer site without a significant TRANSIM training program involved in addition to possible logistical support problems. Using the computer at UCLA involved using research funds that could only provide for approximately fifteen runs on the computer with very limited storage and time allocations.

The general approach of the study progressed consecutively through the following steps:

1. Became familiar with NWS, Concord operation and its facilities.
2. Gathered raw data from the activity.
3. Drafted a rough TRANSIM model to represent the NWS, Concord operation.

4. Organized the raw data and transformed it into usable parameters.

5. Tested the TRANSIM model on the computer for accuracy, realism, and computer efficiency, and subsequently reworked the model and parameters until the original situation was replicated.

6. Varied the parameters to determine limits of NWS, Concord capability.

III. INTENT OF THE PROJECT

The objective of the thesis was to create a simulation model that could predict the maximum export capability of the NWS, Concord. One way to hypothesize the ultimate capability of an activity was to find the historical maximum output of the activity and let that be the maximum capability. This analysis used the historical maximum output of 387,113 long tons in the first half of 1968 (Vietnam War period) as a basis for a simulation model, emphasizing high productive factors and de-emphasizing low productive factors in the activity, to predict greater capability. The system considered for analysis is defined, restrictions and assumptions stated, and then the analysis proceeds. As the study progressed some of the system boundaries and assumptions were changed or modified and are noted.

The Concord facility loads ammunition for many ports in the Pacific Ocean area, often on the same vessel. Of course, stowage of the cargo aboard a vessel requires ordering of the cargo being loaded to insure direct access by the unloading ports. This model has not provided specifically for such ordering of cargo, having thought that this function more properly belongs in the planning phases of transportation and not the operational loading phase. The longshoremen load what is sent to them and it is this aspect of the Concord export mission that is examined.

The research indicated that often many records of data were not available. The intent of the analysis was to take the best available data, both official and unofficial, and,

if appropriate, apply it to the model. Most of the 1968 data was kept at Concord for historical reasons only. Not all divisions in the Concord facility require or desire such information. Consequently some data was from 1968, while other data was from 1976 and 1977, and still other data has never been gathered.

The TRANSIM program has a capability to analyze a system in extensive detail. In the instance of a marine port complex, to model movements of pallets, forklifts, dunnage, railcars and many other small but identifiable units is conceivable, but the expense is great and the time involved is in terms of months and years. This simulation of NWS, Concord was an attempt to model the most significant elements in the determination of export tonnage moved. Every effort was extended to keep the model as real as possible. As the study progressed many decisions regarding the system boundaries and data elements centered on the issue of realism versus model scope and efficiency. To keep the scope and efficiency manageable, assumptions and approximations were necessary, but they were always juxtaposed against the desire for realism to insure the most reasonable product.

This paper progresses by defining the operational process at NWS, Concord, then defining the TRANSIM model in its final forms, followed with a derivation of the specific data. Finally the results are discussed and some conclusions offered.

IV. ASSUMPTIONS

To build the model, assumptions had to be made. First there were broad, general assumptions which held for the entire model and all systems considered. Second, there were specific assumptions which were directly applicable to a portion of the system, an element of data, or a decision rule in the model. However, specific assumptions were not necessarily void of any influence on any other system element or model decision rule. They could indirectly effect another element or rule and could thereby influence results in more than one way. The specific assumptions are listed in Chapter Six while the general assumptions are as follows:

1. An adequate labor force was available to maintain maximum strength of all possible working elements in the port simultaneously.

2. All necessary equipment and maintenance facilities were available to provide sufficient cargo handling capabilities for all possible working elements in the port simultaneously with a nominal deadline rate allowed. The nominal deadline rate was presumed to be whatever was acceptable by the activity during 1968 operations.

3. Sufficient administrative and logistic support was available to supply the needs of operational forces.

4. No container operations were allowed except for the occasional deck stowed container which must be loaded with ship's gear.

5. The year 1968 was representative of a balanced system at NWS, Concord while handling a record amount of ammunition. A balanced system was defined as one where the

inputs equaled outputs, that is, no cargo was created or destroyed within the system.

V. THE NAVAL WEAPONS STATION, CONCORD TIDAL AREA

Before NWS, Concord can begin the planning for and the processing of export cargo, higher authorities outside the facility coordinate land movements of cargo to meet vessels in various ports. From these authorities, notices of vessel arrivals, cargo loads, and destinations are received as well as information on cargo arrival by highway and rail. Upon receipt of this information, NWS, Concord begins planning for the positioning of the cargo in the storage areas and for the handling of the cargo to provide orderly and safe stowage of the cargo aboard the vessel.

A. PLANNING CONSIDERATIONS

The positioning of the vans is essentially void of any restrictions since the parking area is centrally located with respect to the berths and except for the occasional trailer-load of dynamite, the van requires no bunkers or other protection. On the other hand, the positioning of railcars considers the separation of dynamite into specific bunkers and the storage location with reference to the expected vessel's berth. Specific bunkers are assigned for dynamite only, as the need arises. The inflexibility of the routing of railcars due to the layout of the track in the storage area demands extensive planning for the railcar storage location. Therefore, proper positioning of the railcars can prove more efficient when the berth is accessible directly from its storage location instead of indirectly through numerous switches. Although a railcar

can be moved to any berth from any storage location, some of the track is directly accessible to only two or four of the berths.

Vessel berth assignments are dependent upon projected available berths and upon cargo storage location since all the berths have essentially the same physical characteristics. Even though planning is done, the berth assignment is often changed due to a change in priorities or delays of cargo or vessels. These changes can cause previously developed plans to be discarded and inefficient situations to arise.

B. VAN AND RAILCAR MOVEMENT PROCEDURES

When a truck arrives with cargo it is inspected, received (a paperwork accounting process), and sent to a specific numbered location in the storage area. Often the prime highway mover transfers the trailer to a U. S. Navy owned and operated tractor at the receiving point, so that the trailer is parked in the storage area by NWS, Concord personnel. At other times local drayage firms, familiar with NWS, Concord procedures and facilities, are allowed to park the trailer. Once parked, the trailer remains stationary, without tractor, until called for loading aboard a vessel. (Since most trailers are vans as opposed to flatbeds, van and trailer will be used interchangably throughout this paper. Tractor will refer to the prime mover, and truck will indicate a combination of tractor and van or trailer.)

When a train arrives, NWS, Concord railroad personnel are advised, and arrange for the inspection and receiving of the railcars. Then the yardmaster directs switching

operations to segregate the cars into specific numbered bunkers in accordance with the aforementioned plans where they remain in storage until called for a vessel.

When notification of vessel arrival is obtained, operations personnel mobilize the labor and equipment to accomplish the planned loading of the vessel. As specific cargo is required for loading, notification is provided through a central locator to either the railroad or tractor operators to move a particular railcar or trailer from its storage location to a specific location on a designated berth. Once the conveyances have been unloaded, the railroad and tractor operators are again notified of the movement requirements. Later, notification is given to the owner of the trailer or railcar that it has been unloaded and is available again for his use. Once the vessel is loaded with its intended cargo, the vessel is secured, and provided with sailing instructions.

C. AREA CAPABILITIES

The following physical characteristics and operational limitiations of the NWS, Concord facility are noted. The Tidal Area has three quays with two berths each for a total of six berths. It is possible to simultaneously have a C-5 type vessel at each berth while retaining an ability to work all hatches from the quay side of the vessel. Each quay has at least two parallel tracks entering and one track exiting the berth areas expanding to four parallel tracks in the actual vessel berthing area. For safety, no more than twenty-five loaded railcars are allowed on a quay at any one time, with no more than fifteen loaded railcars allowed at a berth at one time.

There are 38 bunkers with a total capacity of 244 railcars. The bunkers are in three sizes, capable of storing either four, eight, or twelve fifty-foot railcars. This number of variously sized bunkers allows many storage configurations, providing compatibility for all classes of ammunition. The distinctions in ammunition compatibility which could effect the rail storage capacity are minimal due to the number of bunkers and their varying size. In addition to the bunkers, there are two classification yards that can be used for storage of 287 railcars providing that the safety requirements, such as the area net explosive weight limitation and ammunition compatibility requirements, are met. Therefore the actual railcar capacity is approximately 531.

The van storage areas consist of two paved and marked parking lots with an approximate total capacity of 200 vans. The ability to store a surge of vans, possibly 150 more, for a short period of time is possible when consideration is given to using unpaved and unmarked open areas and even roadway shoulders. The only limitations for continued efficient operations are localized congestion in a storage area and the distance of the storage area from the berths. Additionally, van cargo is sometimes transferred to U. S. Navy owned railcars on station. This provides an added flexibility if the van storage becomes congested. This analysis considered the van storage capacity at 200 trailers.

In the instances just mentioned, the implication is not that NWS, Concord can store an unlimited number of railcars or trailers. However, it must be emphasized that the stated restrictions on the storage capabilities are not the strict limitations for the entire facility. In fact, in addition to the areas mentioned above, there are additional storage areas in the Inland Area. These other storage areas have

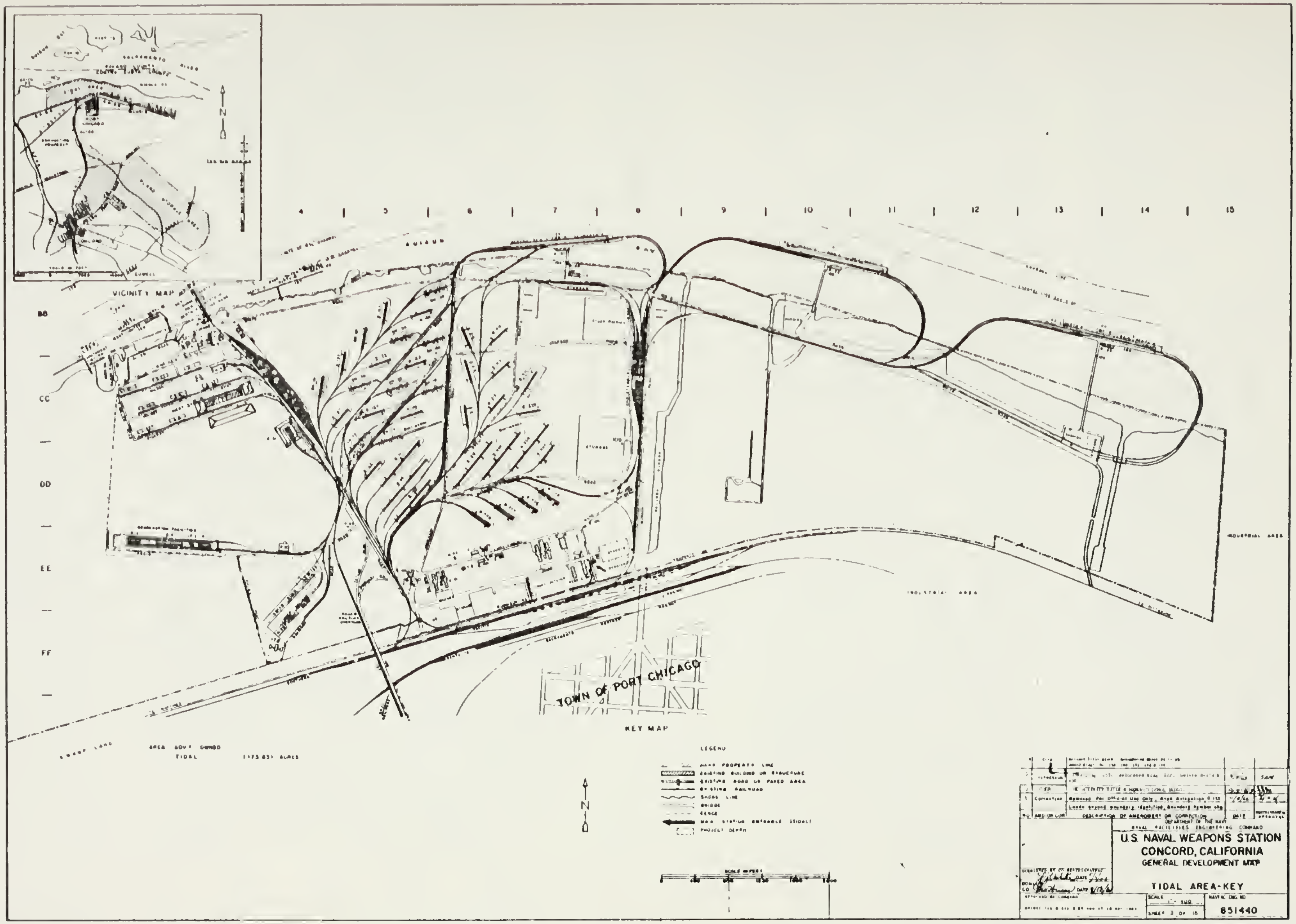

Figure 2 - MAP OF NWS, CONCORD TIDAL AREA

been used in the past, specifically in 1968. It is important to realize that once the normal railcar and trailer storage capacities, 531 and 200, respectively, have been achieved, in all probability the efficient movement of conveyances will decrease. This paper did not analyze how that efficiency varies but assumed maximum efficency can be achieved at the normal capacities stated.

The station also has a barge pier and a large number of barges for use in the port area. The barges can be loaded by mobile pier-based cranes at a separate pier that is accessible to both vans and railcars. This allows cargo to be transferred to a vessel at anchor in the stream or to a berthed vessel from the water side, or simply placed in temporary storage until required for loading aboard a vessel.

D. OPERATING TIMES

Normal operating hours for the longshoremen labor force at NWS, Concord are 0800 to 1700 hours with a one-hour break for lunch. Additionally, fifteen-minute smoke breaks are provided after two hours of each four-hour work period. During periods of two shifts, the second shift is from 2000 to 0500 hours with the same breaks as the first shift. Other employees that interface with or support the longshoremen may start slightly earlier or later. During periods of two shifts, all elements are staffed except for the receiving and inspecting functions which work only eight-hour days.

At the berths, because of safety requirements, there are limitations on when switches of railcars and vans can be made and the size of the switches. Standard operating

procedures at NWS, Concord provide for switches between the hours of 1200 to 1245, 1700 to 1945, 0000 to 0045, and 0500 to 0745 when no cargo operations on the vessels occur. Switches can also be made during the fifteen-minute smoke breaks. Also, safety restrictions limit the number of cars in a single switch anywhere in the Tidal Area to twenty-two railcars.

Additionally, it is mandatory that all vans on the berth be removed from the track area at the berth prior to any movement of railcars, and only after the railcar movement is complete at the berth may vans be placed back in position at the berth for unloading. This procedure must be followed because for unloading, the vans are placed across the railroad tracks and thereby restrict railcar movements.

Nominal time for the movement of trains is forty-five minutes in the berth area. This allows only for the positioning of the cars at the berth and does not include time for retrieving the desired cars from their various storage locations. The retrieval time will depend on the number of cars involved, their relative location, and their grouping. The nominal time for a van movement is twenty to thirty minutes one-way. This provides time for locating the van, connecting it to the tractor, raising the dolly, positioning the van, lowering the dolly, and disconnecting the van.

VI. THE TRANSIM VIEW OF NWS, CONCORD

This chapter portrays the system just described from the view of the simulator. The modifications of the system and the specific assumptions are specified.

A. SYSTEM BOUNDARIES

Originally the boundaries coincided with the geographical perimeter of the NWS, Concord Tidal Area. This allowed three openings in the perimeter for the entry and exit of cargo. Cargo entered the system by rail and truck and left aboard vessels. The empty vessels originated at the system boundary at the quays and after loading at the berths departed the system. However, provision had to be made for anchorage of vessels awaiting an empty berth. Therefore, the system boundary was extended to include a harbor of sufficient size in which to anchor all the vessels that might require waiting.

Also it was intended that the trains and trucks would enter at the boundary gate, the physical device the conveyances actually passed through to enter the Tidal Area. Due to the lack of data and in consideration of the simulation objective, the function was deemed irrelevant. The primary elements in the determination of export capability were the number of vessels, the tonnage loaded, and the capability of the storage areas to accumulate sufficient cargo to keep the vessels supplied with the required cargo while not exceeding the normal storage

capacity. As a result the system boundaries were drawn in to the truck and railcar storage areas.

After the railcars and trucks were unloaded at the berths, they left the system. It was assumed that there existed enough storage space for empty conveyances both within the perimeter of the Tidal Area and on adjacent roads and tracks and/or that the local carriers would pickup their empty trailers and railcars so that the storage of empties would not impact on the tonnage exported.

B. BASIC ELEMENTS OF THE MODEL

The TRANSIM program accounts for the location and activity of traffic units. Traffic units are the smallest identifiable elements in the system. In this model, the traffic units originally were long tons, vans, railcars, and vessels. The greatest problem in the exercise was the organization of the raw data into a form that would provide efficient use of the TRANSIM model within the time and funding constraints dictated. The first computer run providing detail in terms of tonnage (long tons) used an inordinate amount of computer capability, and required reconsideration of the validity of the four traffic units.

Dropping long tons from the primary elements was the first modification of the original plan and resulted in subsequent data approximations and assumptions. The smallest traffic units became the conveyances themselves, specifically the trucks, the vessels, and the railcars. It seemed reasonable to assume an average cargo load per conveyance from which gross tonnages could easily be calculated when needed.

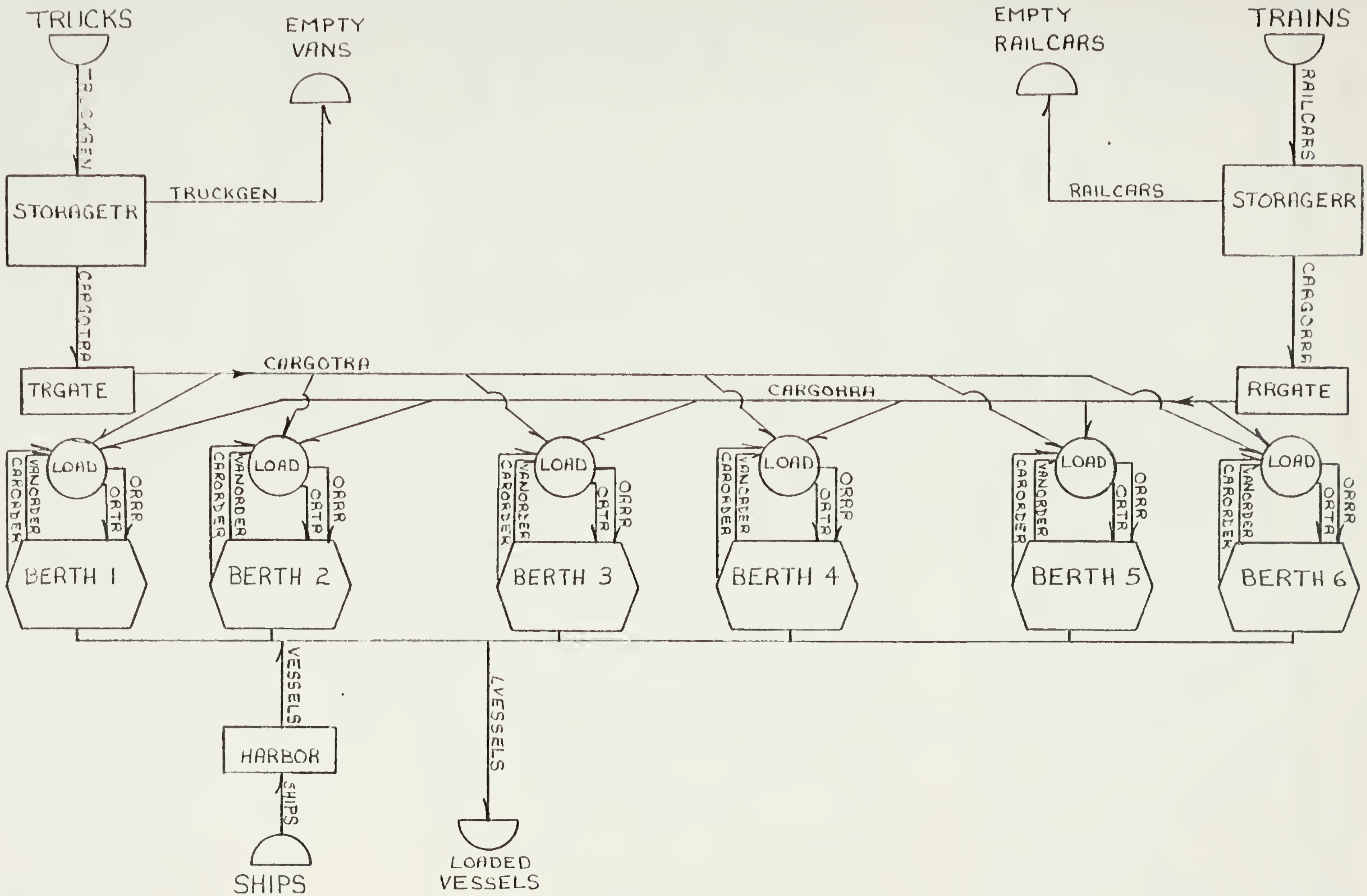

Figure 3 - DETAILED SCHEMATIC

Even though each van and each railcar had the same average tonnage as any other van and railcar, respectively, it was essential for the model to identify each van and railcar to determine times each element spent at a particular activity. Throughout the model, vans were identified individually. However, for trains a further consolidation was deemed necessary after the early test runs continued to show an inordinate demand on computer time and memory while the model was maintaining individual accountability of railcars. Therefore, trains were composed of groups of ten railcars.

This one consolidation caused the most concern in the entire model development. It meant the complete sacrifice of any attempt to model the switching restrictions (22 cars per switch) or berth railcar capacities (25 railcars per two vessels with no more that 15 railcars per vessel) and/or the allowable switching times. To achieve both the most efficient computer use and desired realism was not possible. Efficient computer use required grouping the railcar units. Realism required that railcars be individually identified to facilitate the movement of railcars in both the amounts specified and at only the allowed switching times. Realism had to yield to efficient (in terms of cost) computer use in the model.

C. ALTERNATIVE APPROACHES

The objective of the project was achievable in two ways. The model could be structured to generate cargo from the storage areas at a prescribed rate and load the vessels to a predetermined capacity at which time they would sail. Then a comparison of simulated berth times with actual berth

times would render possible conclusions. Alternatively, the vessels could be called in berth for a prescribed time to load a predetermined amount of cargo. Then comparisons could be made between the simulated accumulation of cargo in the storage area with the physical ability of the storage areas to efficiently handle the cargo. The latter approach was chosen for the following reasons:

1. Berth time data was available while cargo arrival, storage, and handling times could only be guessed, because historical data was not available and current data was insufficient.

2. The second alternative seems more realistic in that plans are usually made first for the vessel's cargo while the handling and storage capabilities of the port are secondary conditions, if considered at all.

Using total berth time as a driving force allowed the model to be less detailed than the switching time restrictions, switching size limitations, and the berth railcar capacity limitation required. The ten-railcar traffic unit appeared to be a plausible approximation. Two of the consolidated units were 91 percent of maximum switch size. If only one vessel was at a quay, a consolidated unit was 67 percent of the berth railcar capacity, and if two vessels were in adjacent berths, a more likely situation when trying to maximize tonnage output, two units were eighty percent of capacity. If one consolidated unit of ten railcars was associated with a vessel, none of the safety restrictions would be violated and, assuming that a requirement for all switches and berth railcar storage capacities to be maximized all the time is not realistic, the number of railcars available for unloading on the berths was tolerable.

Regarding the only other variable, switching time restrictions, the allowance for the switching time had to be realized in a reduction of the unloading rate. Implicit in this arrangement was the assumption that the units of ten railcars was neither too large nor too small to have a significant effect on the tonnage loaded, and that in the long run the cargo loaded during switching times would balance the lack of cargo during cargo loading times.

D. DATA ELEMENTS

Raw data was obtainable either from records or interviews for most elements within the Tidal Area. The data base consisted of either capacity elements or time elements. Capacity elements included vessel loading space, van and train storage capacities, and tonnages on vans, railcars, and vessels. Time elements were vessel loading and vessel total berth times, interarrival times of trucks, trains and vessels, inspection and receiving times of vans and railcars, movement times of vans and railcars both from receiving to storage and from storage to berths for unloading, and unloading times of vans and railcars.

1. Capacity Elements

Storage and berthing capabilities were taken from existing facilities in April 1977. These were the same as in 1968, except for the first forty-five days of 1968, when two of the berths were still under construction. (All 1968 data in the model has been prorated to provide an equivalent full year's capability.) In the past, vessels at NWS, Concord have occasionally loaded cargo, usually in very small tonnages, while at anchor 'in the stream and have

loaded vessels from the harbor side of a vessel while at a berth. The stream operation was not considered in the model but the barge operation on a berthed vessel, while not specifically modeled is allowed in the way the model evolved. Therefore six vessels, one per berth, were considered loadable at any one time.

The model assumed a nominal storage capacity of 530 railcars and that safe storage could be provided all types of ammunition. For the model the van storage capacity was 200. Storage of cargo on barges was not included in the model.

In 1968 NWS, Concord exported a record number of long tons of ammunition and this was thought to be the most appropriate year in which to base the model to determine the port's ultimate capability. The official manifest tonnages of 1968 vessels were available and were used in the model. The data indicated a broad spectrum of tonnages loaded aboard vessels, from eight tons to over ten thousand tons. In order to categorize vessels, they were divided into ten classes, each class with a range of one thousand tons. This allowed for a distribution of tonnage by class and also a distribution of vessel frequency by class. For each class an average tonnage was calculated and used as the tonnage for that class of vessel.

Truck and rail tonnages were not available for 1968. This data was taken from 1976 records and averaged to obtain a nominal tonnage per conveyance. The implicit assumption is that the tonnage per conveyance would not change significantly over time.

2. Time Elements

Much of the time data was not recorded; in fact, only the total berth times of the vessels were recorded. However, from the berth time data, vessel interarrival times were calculated. Although not recorded, the working time of a vessel was the only other time data that had a possibility of validation. Records did not indicate the precise working and non-working times on a vessel. Since only a guess, based on normal working hours, could be made on vessel loading times, all vessel tonnage capacities and loading rates were based on total berth time. To determine the port capability two shifts were assumed.

Because of the adjustments of the system boundaries to the storage area, it was not necessary to represent inspection times, receiving times, or movement times of vans and railcars into their respective storage areas. The critical issue was to show an arrival of vans and railcars into a storage area where they could be available for unloading to a vessel. But no records of truck or train interarrival times were available. To model cargo arrivals, NWS, Concord employees were interviewed to obtain their "best guess." For vans, the arrival process occured over an eight-hour span in the day shift, while the railcars were usually moved in a group at one time during the day or in groups of railcars just a few times a day.

The simulation allowed trains to arrive only at 0800 hours, precluding multiple time arrivals during the day. Since the usual practice in ports is to have cargo on hand prior to a vessel's arrival, this assumption was not unrealistic. However, to simulate the arrival of different numbers of railcars during a day the number of train arrivals was said to obey a distribution of one train arrival 50 percent of the days and either no train arrivals or two train arrivals, each 25 percent of the days. Depending on expected vessel berth occupancies, the number

of trains, with ten cars per train, could be probabilistically varied to satisfy the vessel cargo requirements. The overriding influence was to balance inputs with outputs and ensure sufficient railcars in storage to allow the system to operate in apparent realism.

Truck arrivals were simulated differently. It seemed appropriate to represent truck arrivals by a Poisson distribution. Except for a possible buildup early in the receiving period, the Poisson distribution would represent a random arrival pattern. However, the stipulation was included that trucks could be received only between 0800 and 1600 hours to simulate the real-life situation of trucks being received for only one eight hour shift. The Poisson distribution worked on a twenty-four hour basis but specific rules were included in the program to cause trucks that arrived between 1600 and 0800 hours to leave the system with no other action. The mean interarrival time was dictated by balancing the output of trucks with the input of trucks for the system. The mean interarrival time was calculated by dividing the allowed eight hour receiving period by the average number of trucks to be input daily into the system. Again, the effort was directed to ensuring sufficient arrivals in the period to match the demands of cargo by the vessels.

As a check of this hypothesized model, the timing of cargo input was considered a function of tonnage, as already inferred. To provide for cargo input, cargo coming into the system was assumed to equal the cargo coming out of the system over a long period of time. Specifically the model was structured to have the cargo entering by trucks and trains equal the cargo loaded on vessels in a six month period. With the knowledge of the tonnage exported and the tonnage per truck and train, only the arrival rates had to be determined for the trucks and trains. However, the ratio

of vans to railcars was not available. A "best guess" by some of the experienced employees at NWS, Concord was the best information available. A ratio of three railcars to every truck was determined to best represent the actual situation.

The only unresolved times were van and railcar movement times from storage to berth and the railcar and van unloading times. Again no specific records were available and the basis of the model was conversation with experienced NWS, Concord employees. The best solution was an attempt to represent the vessel berth time in terms of cargo loaded. Assuming the ratio of railcars to trucks remained the same as the receiving rate (three to one) it was possible to calculate a vessel loading rate.

The model did not count the movement time from storage to berth. In effect, this time is made a part of the loading time of the vessel. Without including the switching limitations described earlier, the movement time has no meaning in any case.

E. SYSTEM SUMMARY

In summary the model is set up with three independent variables: vessels, vans, and railcars, and several dependent variables, which cannot be statistically verified. Therefore several pilot runs of the program were made, relying on the author's judgement to recognize an improbable result and correct it. Apparent errors in the functional data relationships were found, and production runs were not made until the model was able to replicate real situations in the past. The actual operating rules of the model are defined in Appendix A.

The specific assumptions stated above are summarized as follows:

1. Local carriers pick up empty conveyances or sufficient van and railcar storage space exists such that empty vans and railcars do not impact on export tonnage.

2. Movement times of conveyances from storage to berth, and switching limitations can be incorporated into an average vessel loading time for all classes of vessels.

3. Vans and railcars consolidating pallets of cargo can properly represent tonnage loaded aboard the vessel.

4. Railcars in groups of ten can be moved as a unit throughout the system.

5. The historical relationship between vessel tonnage and berth time is valid for any time period.

6. The cargo mix of various explosive categories can be safely stored in the normal areas.

7. The randomness of the simulation's Monte Carlo technique provides mean values over a six month period.

8. Hypothesized arrival distributions and interarrival times are valid approximations of the real situation.

9. The average ratio of railcars to trucks in and out of the system is three to one.

10. Loading operations with vessels in the stream are not allowed.

11. The average van and railcar tonnages are constant over time.

VII. THE DERIVATION OF THE PARAMETERS

Numerous assumptions have been made in an effort to transform the real situation into a form acceptable for both the TRANSIM program and efficient computer utilization. It is only appropriate to be more specific in the methods used to organize the raw data into parameters. Throughout all the simulation runs the distribution of vessel classes, the vessel class berth times, the number of vans and railcars per vessel class, the unloading times of vans and railcars, and the interarrival time of trains were the parameters held constant. These constant parameters are now described, while the parameters that were changed to create different effects in the simulation are described later.

A. PARAMETERS HELD CONSTANT

1. Distribution of Vessel Classes

For each vessel that arrived and departed (made a turnaround) from January 1968 through June 1968, the raw data furnished the name of the vessel and its manifested tonnage in long tons. This data was ordered and plotted in histogram fashion (Appendix J) with ten equal intervals of tonnage (the intervals were all equal to 1000 tons except the interval at the highest range of tonnage which was allowed to include all greater tonnages) plotted against the number of vessels. The number of tonnage intervals and the interval length itself were arbitrarily designated. The

lowest tonnage interval (0 to 1000 long tons) was assigned class 1, and the classes progressed consecutively higher to class 10 (9000 long tons and above). By dividing the number of ships in each class by the total number of ships (76), a distribution of vessels by tonnage class was achieved (Figure 4). In the TRANSIM program this distribution was called the "shiprule."

One qualification of the raw data stated above must be clarified. Recall that the only data used was for ships that completed a turnaround within the six month period. This eliminated any vessels on berth at the beginning of the period and also those that failed to complete operations by the end of the period. Remember also that AEs are not included and that vessels involving any discharge operation are not included.

VESSEL CLASS	PERCENT OF VESSELS
01	6.6
02	2.6
03	2.6
04	7.9
05	18.4
06	30.3
07	21.1
08	7.9
09	1.3
10	1.3

Figure 4 - VESSEL CLASS DISTRIBUTION

2. Vessel Class Berth Times

The same raw data above also contained the vessel's arrival and departure times from its berth. From that data total berth times, to the nearest quarter hour, were calculated for each ship and plotted against the vessel class in which that ship belonged. Within the vessel classes, there appeared no correlation between vessel berth time and tonnage loaded. However, there was a trend of increasing berth time with corresponding increase of vessel class, which was expected.

The berth times in each vessel class were simply averaged to obtain a mean. To give the same randomness to the simulation that the raw data for each class did reflect, a ten percent spread on either side of the mean was arbitrarily assigned to a triangular distribution (Appendix K). (The triangular distribution is a device incorporated in TRANSIM that assigns probabilities). The variance was strictly arbitrary and was adjusted for the large class vessels, after test runs indicated invalid results in which the higher class vessels were not able to achieve their prescribed tonnage in the allotted time. Therefore, vessel classes eight, nine, and ten had increased variances to rectify this problem (see page 48 for discussion of loading times). Figure 5 gives the distribution of berth times for the various vessel classes.

VESSEL CLASS	TIME ON BERTH		
	LEAST	AVERAGE	MOST
01	103	114.3	125
02	137	152.6	167
03	165	183.4	201
04	170	189.2	208
05	184	204.1	224
06	186	206.1	226
07	190	211.4	232
08	192	213.9	240
09	198	220.0	280
10	221	245.5	340

Figure 5 - BERTH TIMES BY VESSEL CLASS

3. Vans and Railcars per Vessel Class

It was desirable to make the tonnage for each class of vessel an even multiple of the railcar tonnage to avoid the necessity of accounting for partial loads in vans and railcars, which would be another burden upon computer storage and a complicating element in the model. Therefore the vessel tonnages, although based on the average tonnage, were approximations.

To determine the tonnage unit required, the average tonnages per van and railcar were found. The only reasonable record of van and railcar tonnages was from 1976. It is logical to expect the average tonnage of vans and railcars to be relatively constant over time. The one possible cause for variance might be the nature of ammunition required due to a particular type of conflict (napalm bombs are much lighter than explosive bombs).

Van and railcar tonnages were based on data generated in the first six months of 1976. The average long tons per van and the average long tons per railcar were calculated to be 15.9 and 53.2 respectively. After many trials at what might have been even multiple combinations that seemed reasonable, 18 long tons was chosen as the average weight of a van with 54 long tons the average weight of a railcar. Consequently each average vessel tonnage was rounded to the nearest multiple of 54 long tons.

Although these tonnages were included in the computer input data, they were not actually used in the simulation due to the elimination of the long ton traffic unit. Figure 6 shows the actual average long tons per vessel class and the average used in the simulation.

VESSEL CLASS	LONG TONS SIMULATED	ACTUAL
01	540	540
02	1674	1670
03	2160	2154
04	3726	3738
05	4536	4551
06	5400	5409
07	6480	6462
08	7398	7422
09	8154	8163
10	10152	10132

Figure 6 - ACTUAL VS. SIMULATED TONS PER VESSEL CLASS

The number of railcars and vans per vessel class was an easy calculation once the ratio of railcars to vans was established. Applying the 3:1 ratio assumed above, the solution of two simultaneous equations provided the number of vans and railcars. The equations were:

1.) CARGO TONNAGE ABOARD VESSEL =

(NUMBER OF VANS)(18 LONG TONS PER VAN) +
(NUMBER OF RAILCARS)(54 LONG TONS PER RAILCAR)

2.) NUMBER OF RAILCARS = 3(NUMBER OF VANS)

The general feeling of personnel at NWS, Concord was that the tonnage received in railcars in relation to the same for trucks had decreased in the past few years. Without data this was impossible to verify and it is only hoped that the data, if available, would prove relatively consistent with what has been hypothesized. When it became apparent that the grouping of railcars into units of ten was a more efficient way to model the system, the result was a necessary rounding of the number of railcars, or trains, per vessel to the nearest multiple of ten and consequently an effect on the van/railcar ratio to achieve the desired tonnage per vessel class. The results of this consideration is summarized in figure 7.

VESSEL CLASS	VANS		RAILCARS	
	ACTUAL	THEORETICAL	ACTUAL	THEORETICAL
01	3	3	10	9
02	3	9	30	28
03	0	9	40	37
04	27	18	60	63
05	12	27	80	75
06	30	30	90	90
07	30	36	110	108
08	51	42	120	123
09	33	45	140	136
10	54	57	170	169

Figure 7 - ACTUAL AND THEORETICAL NUMBERS OF VANS AND RAILCARS PER VESSEL CLASS

Consideration was given to making the distribution of railcars and vans per vessel random, but was not implemented for three reasons. First there would be no assurance that the length of time or number of vessels generated in the simulation would be sufficient to cause the average tonnage in a vessel class to achieve its desired level. Secondly, the vessel berth time was an independent and overriding factor on tonnage loaded, that is, even though the simulation may have generated a higher than average number of railcars and vans for a vessel, there was no way they could be loaded on the designated vessel once its berth time had elapsed. Finally, the distribution would have been a guess, and that would only compound the uncertainty already incorporated in this part of the model. This determination of traffic units per vessel was necessarily uncertain and, regrettably, the detail which was initially desired sacrificed.

4. Unloading Times of Vans and Railcars

As previously discussed, the actual time of loading the cargo from vans and railcars onto the vessel was not documented in records at NWS, Concord. In any instance, this would have been difficult to correlate with the total berth time of the vessel which also included significant amounts of non-productive time. Therefore by trial and error, considering the number of traffic units necessary to achieve a desired vessel tonnage class, the ratio of trucks and vans unloaded, and the berth time of the vessel, unloading rates were obtained. The nominal times used were ninety minutes for a van and two hours for a railcar. To an experienced port operator these times may seem high. But recall that this rate of unloading considers not only the sixteen hours of available productive time in a twenty-four

hour period but also, shift changes and breaks, meal times, vessel rigging times, cargo compartment opening and closing times, blocking and bracing times, vessel time between docking and commencement of operations and time between ceasing of operations and sailing time, cargo delays, equipment breakdowns, and short hatches. The figures seem more plausible when the average tons loaded on a vessel per hour of berth time for the January 1968 through June 1968 period was 25.8 long tons. In the pilot runs of the simulation these times were analyzed very closely to insure that the cargo was loaded within reasonable times of the vessel departure. The times were adjusted somewhat, along with vessel berth times (see page 41) to insure the simulation was as realistic as possible.

Dependent upon the type of cargo in the vans or railcars the unloading rate could vary. Based on interviews with operating personnel at NWS, Concord a spread on either side of the mean loading times of 45 percent for vans and 30 percent for railcars was assigned. In the pilot runs this randomness was monitored and provided reasonable realism to the simulation.

5. Interarrival Time for Trains

The basic idea for rail arrivals was to have an average of one train a day arrive and to vary the number of railcars in the train to make the number of railcars variable. However, it was a simple task to also vary the number of trains per day and achieve more realism. Therefore, still basing the train input on a mean interarrival time of one per day, the number of trains was allowed to vary from 0 through 2 per day on a stepwise uniform distribution.

B. PARAMETERS TO BE VARIED IN SIMULATIONS

The variable elements of data include the interarrival time of vessels, the interarrival times of trucks, and the number of railcars per train.

1. Interarrival Time of Vessels

The average interval between ship arrivals was calculated from the number of vessels in the six months compared with the total time in hours. The original result, based on seventy-six vessels, was a mean interarrival time of fifty-seven hours. The distribution of arrivals was specified as Poisson. The Poisson distribution was used throughout the simulation runs but the mean interarrival time was changed depending on the number of vessels desired for berthing in each run.

With the available berth time for six berths over 180 days equal to 25,920 hours, and the historical data base giving an average of 197.5 hours berth time per vessel, the equations used to calculate the mean interarrival time were:

1.) NUMBER OF VESSELS =

$$\frac{\text{TOTAL BERTH OCCUPANCY TIME}}{\text{AVERAGE BERTH TIME PER VESSEL}} =$$

$$\frac{\text{(OCCUPANCY RATE) (AVAILABLE BERTH TIME)}}{\text{AVERAGE BERTH TIME PER VESSEL}} =$$

$$\frac{\text{(OCCUPANCY RATE) (25920 HOURS)}}{\text{197.5 HOURS PER VESSEL}}$$

2.) INTERARRIVAL TIME =

$$\frac{\text{TOTAL TIME}}{\text{NUMBER OF VESSELS}}$$

2. Interarrival Times for Trucks

The distribution for truck arrivals was also assumed to be Poisson. For the original runs the mean interarrival time was forty-five minutes. With this distribution the number of trucks entering, leaving, and stored in the storage area seemed reasonable in the test runs. However, when greater tonnage requirements existed due to increased berth occupancy it was noted that the relationship between truck arrivals and vessel classes on berth was extremely critical. When vessels that required great numbers of vans were in a berth, there were insufficient numbers of vans in storage to satisfy the demand. Therefore, in later runs, the mean arrival rate was arbitrarily increased and decreased depending on the supply of trucks, resulting in a non-homogeneous Poisson distribution. This gave added realism to the model because the nature of truck transportation and truck detention rates are such that trucks are used when the interface time with another mode is imminent or short. To calculate the mean time when the vessel loading requirements were varied, the following equations, with the historical data base giving an average of 25.197 vans per vessel (assuming the 3:1 railcar:van ratio, adjusted only for rounding due to the grouping of railcars), were used:

1.) NUMBER OF VANS PER DAY =

$$\frac{\text{(25.197 VANS PER VESSEL)(NUMBER OF VESSELS)}}{\text{NUMBER OF DAYS PER PERIOD}}$$

2.) VAN INTERARRIVAL TIME =

$$\frac{\text{(8 RECEIVING HOURS PER DAY)}}{\text{NUMBER OF VANS PER DAY}}$$

3. Number of Railcars per Train

The number of railcars per train was a direct result of balancing inputs with outputs. The average number of trains (ten railcars per train) per vessel was 8.593, from the historical data base (assuming again the 3:1 railcar:van ratio, adjusted only for rounding due to the grouping of railcars). The following equation provided the number of trains required:

NUMBER OF TRAINS =

$$\frac{\text{(8.593 TRAINS PER VESSEL) (NUMBER OF VESSELS)}}{\text{NUMBER OF DAYS PER PERIOD}}$$

If the result contained a fraction, for example 5.4, then cars per train was given a distribution of 60 percent of the trains with five groups of ten railcars and 40 percent of the trains with six groups of ten railcars which provided a mean of 5.4 groups of ten railcars per train.

VIII. RESULTS

Five simulation runs of 180 day periods were made. The first three runs, I, II, and III, were made in order to replicate the original situation. Simulation runs IV and V were made with the parameters varied to attempt to find the upper limit of NWS, Concord's capability. The results of the study are included as Appendices E through I and are summarized in Figures 8 and 9.

Simulation runs I, II, and III were the runs that attempted to validate the model's accurancy, comparing percent of berth occupancy, total export tonnage, and number of ships of the historical data with the simulation results. The historical data indicated a total of 76 ships exported approximately 387,000 long tons with a 62.5 percent berth occupancy for the first six months of 1968. Although there was a small variance in the three runs' results they bracketed the original historical data very satisfactorily. Simulation run II was almost identical with the historical data.

The remaining data generated in the simulation could not be validated historically but could be compared with actual facilities in an attempt to judge the result's plausibility. Particular attention was given the vans and railcars in storage. Simulation run I generated a seemingly high number of vans and railcars in storage. To a degree, this was to be expected in comparison with simulation runs II and III in that the cargo was arriving at the same rate but fewer ships were loaded.

However, further detailed analysis indicated an adjustment in the van arrival rate might be necessary because the number of vans was steadily increasing. Therefore, simulation runs II through V had variable van arrival rates applied to the model to reflect fewer arrivals when vans in storage approached capacity and more arrivals when vans in storage were low. Henceforth, on the average, the storage requirements were consistently within the van storage capacity with the normal capacity being exceeded only in one run by 26 vans which was felt to be tolerable.

Railcars in storage did not indicate any specific necessary adjustments, but proved somewhat inconsistent. The inconsistency was noticeable in the trends of berth occupancy, tonnage exported, and the number of vessels, none of which had any correlation with the numbers of railcars in storage. For simulation runs I and V there are significant differences from runs II, III, and IV in the average number of railcars in storage.

There was another trend that had to be considered in the seeking of a maximum export tonnage. The percentage of ships turned around without any delays waiting for berth generally decreased as the berth occupancy and tonnage increased. This appeared to be logical in that unless vessels were following an extremely precise schedule, there would undoubtedly be delay times somewhere in their voyage. Every time a vessel is delayed, that vessel is not producing revenue or moving any cargo for the charter price of the vessel. An idle vessel can be extremely costly. The results indicated that high berth occupancy, although having produced large tonnages, also produced more vessel delays.

The results indicated that the greatest export tonnage in a 180 day period is about 610,000 long tons. This required 127 vessels of the assumed distribution with 99.8

percent berth occupancy. However, this operation could be extremely costly due to the number of vessels in a queue awaiting a berth. Such a high berth occupancy rate is not a very probable operation because too small an allowance is provided for vessel switching times and other delays that are bound to occur in the real situation. It was notable that such a high berth occupancy put demands on the storage facilities that were felt to be tolerable.

A more reasonable export tonnage mark to be sought is about 500,000 long tons which required 97 vessels of the assumed distribution with 77.5 percent berth occupancy. The only unfavorable factor appears to be the ship delays. The cost of ship delays may be significant, possibly somewhere between the cost of the historical operation in 1968 and the hypothetical 610,000 export tons operation. However, a 77.5 percent berth occupancy allows for the possible discharge of vessels, the handling of AEs, and/or the vacant time that would probably occur.

An element of concern could be expected when analyzing storage requirements for such a tonnage exported. Again, the data was not conclusive, but consideration had to be given requirements posed by this simulation that showed the normal railcar storage capacity would be seriously deficient, requiring 1.8 times the nominal capacity on the average and with a peak of three times the nominal capacity.

STATISTIC	SIMULATION RUN				
	I	II	III	IV	V
Berth Occupancy	52.7	60.3	69.3	99.8	77.5
Van Exports (No.)	1650	1929	2253	3132	2496
Van Exports (Tons)	29700	34722	40554	56376	44928
Rail Exports (No.)	547	597	659	1026	840
Rail Exports (Tons)	325080	322380	356860	554040	453600
Total Exports	354780	357102	397414	610416	498528
Number of Ships	69	77	90	127	97
% Ships W/O Delay	87.9	64.9	66.3	0.0	44.3
Max. Vans Stored	345	226	185	150	196
Ave. Vans Stored	177	98	55	55	94
Max. Cars Stored	1420	500	650	520	1530
Ave. Cars Stored	722	114	136	105	900
Ave. Time Van Stored	366.0	204.5	96.0	72.2	153.9
Ave. Time Car Stored	454.3	78.5	75.0	42.5	404.9

Figure 8 - COMPOSITE RESULTS

VESSEL CLASS	SIMULATION RUN				
	I	II	III	IV	V
01	8	8	6	8	5
02	1	0	4	4	1
03	2	1	0	5	4
04	7	4	8	5	12
05	10	14	18	25	16
06	23	22	25	35	22
07	14	22	20	30	27
08	4	5	8	12	9
09	0	0	1	3	1
10	0	1	0	0	0
TOTAL	69	77	90	127	97

Figure 9 - ACTUAL NUMBERS OF VESSELS IN EACH CLASS FOR EACH SIMULATION

IX. CONCLUSIONS

This thesis has attempted to both define a simulation model for an ammunition water port, specifically NWS, Concord, and to utilize that model to determine a potential capability of the port. The analysis has been limited in scope but is useful in modeling a port in general terms. Two conclusions can be drawn from the analysis. First, NWS, Concord can export a significant increase in tonnage, up to approximately 610,000 long tons, and second, the impact on the storage areas is not conclusive.

To increase the actual export tonnage loaded aboard vessels is a distinct possibility but it has some very definite costs. Such an operation excludes any discharge operations and precludes the servicing of any AEs. In 1968, AE's occupied a berth at NWS, Concord 7.5 percent of the time, while vessels involved in discharge were present 11 percent of the time. If it is possible to perform the responsibilities incurred with these vessels at another port, the increased tonnage provided by merchant marine cargo type vessels instead, could be significant. However, to insure sufficient vessels are on hand to receive the increased tonnage, would necessitate a great increase in the vessel delay times awaiting berth. A cost-benefit analysis would be appropriate to determine the break even point between the increased capability and the increased cost from non-productive vessels. An indication of the trend of delay times and tonnage capabilities can be obtained by comparing simulation runs II, IV, and V.

The increased tonnage just mentioned is a realization of

the capability provided by the number of vessels, berth space, and vessel loading rates. However, to conclude anything about the ability of the storage areas to handle such amounts of tonnage is not so easy. It is difficult to determine with the results herein what might happen in the storage areas. There are no definitive trends that would indicate whether the storage areas are sufficient under the conditions analyzed.

The extreme variances in the results do indicate that the vessel class mix, the sequence of vessel class arrivals, and even the railcar/van ratio loaded aboard a vessel are extremely important. That the model could not be detailed in this area may be the reason for the indecisive results. The assumptions made regarding the distribution of vans and railcars aboard a vessel have a direct effect on the drawdown or buildup of conveyances in the storage area.

Any conclusions about the storage area need to have more runs made and possibly a better data base regarding cargo types loaded aboard a vessel and the frequency of such cargo types.

It is worthwhile to have the model developed as it does at least provide a vehicle to analyze an ammunition port with a rather standard operation. The model can be used for comparative analysis between ports and, with more replications, may provide more conclusive results. TRANSIM is a tool that has proven relatively easy to use, at least in this rather general view, and is worthy of more use in this area.

X. RECOMMENDATIONS

Further study of this port could prove both interesting and worthwhile. Future analysis of the same system might explore a number of areas.

To increase the number of runs, if funds were available, for a broader statistical base would be of considerable value. Different seeds to the random number generator could be used and the variable parameters could be changed to generate possibly different and/or more conclusive results.

Although it would require a greater expense, the system could be redefined to include some of the more detailed operations or those that had to be excluded. This might provide more realism in that some of the assumptions could be deleted. Such detail, however, would require a broader raw data base on which to base the new operations.

Obviously one area that can be studied is the relationship of the storage requirements with cargo input and vessel loading. It is suggested that this might be a reasonable study, with limited funds, that involves primarily an analysis of the constant parameters. A number of runs changing these data elements might prove most illuminating.

APPENDIX A

OPERATING RULES OF THE MODEL

The operating rules of the model are defined in the order cargo might flow through the system. Some duplication is necessary to provide for the movement of cargo by the two modes of van and railcar. The index to the left of the discussion of each element or rule refers to the sample program in Appendix B.

1. Trains (ten railcars each) are generated randomly by a given interarrival time distribution.

   Example: 25 P 0 50 P 1 DAY 25 P 2 DAY

   Interpretation: 25 percent of the days no trains will arrive; 50 percent of the days one train will arrive; 25 percent of the days two trains will arrive.

2. The multiples of ten railcars per train are generated randomly by a given distribution.

   Example: NRR = 50 P 3 50 P 4

   Interpretation: 50 percent of the train arrivals have 30 railcars and 50 percent of the train arrivals have 40 railcars.

3. At the storage area a train substitutes into a number of railcars.

   Example: TRAIN S RULE NRR RAILCAR
   RAILCAR S CARGORRA
   CARGORRA R RRGATE

   Interpretation: At the storage area a train substitutes into a number of railcars

just determined (by the previous two steps) which substitute into rail cargo units which are routed from the storage area to a checkpoint (RRGATE).

4. Trucks are generated randomly by a given interarrival time distribution.

Example: TABLE TARTRCK POISSON 45 MIN

Interpretation: A truck will arrive according to a Poisson distribution with mean interarrival time of 45 minutes.

5. At a checkpoint trucks will be routed dependent on the time of day.

Example: ELEMENT TRORIG

```
TRUCKEN S TRUCKGEN + CARGOTRA
CARGOTRA R  800 AM 0
           1600 PM STORAGETR
           2400 PM 0
```

Interpretation: At the point TRORIG, trucks will be routed to the truck storage area if between 0800 and 1600 hours on the day clock; otherwise they will leave the system.

6. At the storage area van cargo units are routed to TRGATE.

Example: ELEMENT STORAGETR

```
CARGOTRA R TRGATE
```

Interpretation: Vans enter the storage area and will flow out through a "gate" as vans of cargo (CARGOTRA).

7. Vessels are generated randomly by a given time distribution.

Example: TABLE TARVSH POISSON 57 HR

Interpretation: A vessel will arrive according to a Poisson distribution with a mean interarrival time of 57 hours.

8. The vessels that arrive enter the system as one of

ten classes with a given distribution.

Example: SHIPRULE = 6.6 P VESSEL01
7.9 P VESSEL04
21.1 P VESSEL07

Interpretation: 6.6 percent of vessel arrivals will be class 1; 7.9 percent of the vessel arrivals will be class 4, and 21.1 percent of vessel arrivals will be class 7.

9. The vessels of a particular class are given a random total berth time according to a given distribution.

Example: TABLE BERTH05 TRIANGLE 0 P 184 HR 204.1 HR 224 HR

Interpretation: A vessel of class 5 will have a berth time according to a triangular distribution where zero percent of the time it will be on berth 184 hours or less, 50 percent of the time it will be on berth 204.1 hours, and zero percent of the time it will be on berth 224 hours or more.

10. The vessel is assigned a berth.

```
Example:  ELEMENT HARBOR
          SHIP S RULE SHIPRULE
          VESSEL** R BERTH1 IF VESSEL** EVESSEL**
               AT BERTH1 EQ 0  OW
          VESSEL** R BERTH2 IF VESSEL** EVESSEL**
               AT BERTH2 EQ 0  OW
          ETC.
          VESSEL** R BERTH6 IF VESSEL** EVESSEL**
               AT BERTH6 EQ 0  OW
          WAIT
```

Interpretation: The arriving vessel goes to berth 1 if there is no vessel of any class at berth one; otherwise it screens berth two, three, four, etc., until it finds an empty berth. If all berths are full it waits until a berth empties and then occupies it.

This page intentionally left blank.

APPENDIX B

SAMPLE OPERATING RULES

This appendix contains a sample of the operating rules used by TRANSIM for the NWS, Concord model. The indexed portions of the figures are explained in Appendix A.

NWS CONCORD EXPORT CAPABILITY

LISTING OF SIMULATION INPUT DATA

```
           NWS CONCORD EXPORT CAPABILITY                SIX MONTHS    17MAY77
           22000
           DEFAULTS   MAXCOLUMN 80 MAXERRORS 20         ALL LOG NO  ROOT 81739237
           DEFINITIONS
  (8)          SHIPRULE  =  6.6 P VESSEL01        2.6 P VESSEL02      2.6 P VESSEL03
                            7.9 P VESSEL04       18.4 P VESSEL05     30.3 P VESSEL06
                           21.1 P VESSEL07        7.9 P VESSEL08      1.3 P VESSEL09
                            1.3 P VESSEL10
  (2)          NRR  =   50 P 3   50 P 4
               NLTON01  =   100 P 549
               NLTON02  =   100 P 1674
               NLTON03  =   100 P 2160
               NLTON04  =   100 P 3726
               NLTON05  =   100 P 4536
               NLTON06  =   100 P 5400
               NLTON07  =   100 P 6480
               NLTON08  =   100 P 7398
               NLTON09  =   100 P 8154
               NLTON10  =   100 P 10152
               NVAN01  =   100 P 3
               NVAN02  =   100 P 3
               NVAN03  =   100 P 0
               NVAN04  =   100 P 27
               NVAN05  =   100 P 12
               NVAN06  =   100 P 30
               NVAN07  =   100 P 30
               NVAN08  =   100 P 51
               NVAN09  =   100 P 33
               NVAN10  =   100 P 54
               NCAR01  =   100 P 1
               NCAR02  =   100 P 3
               NCAR03  =   100 P 4
               NCAR04  =   100 P 6
               NCAR05  =   100 P 8
               NCAR06  =   100 P 9
               NCAR07  =   100 P 11
               NCAR08  =   100 P 12
               NCAR09  =   100 P 14
               NCAR10  =   100 P 17
           ELEMENT TRCRIG
  (5)  (4)   TRUCKGEN T TR15 IF CARGOTRA AT STORAGETR LT 10
                       OW TR75 IF CARGOTRA AT STORAGETR GT 150
                       OW TR45
             TRUCKGEN S TRUCKGEN + CARGOTRA
             CARGOTRA R   800 AM 0
                         1600 PM STORAGETR
                         2400 PM 0
           ==
           ELEMENT HARBOR
  (10)         SHIP S RULE SHIPRULE
               VESSEL** R BERTH1 IF VESSEL** EVESSEL** AT BERTH1 EQ 0  OW
                          BERTH2 IF VESSEL** EVESSEL** AT BERTH2 EQ 0  OW
```

Figure 10 - SAMPLE OPERATING RULES INPUT

```
NWS CONCORD EXPORT CAPABILITY
                                BERTH3 IF VESSEL** EVESSEL** AT BERTH3 EQ 0  OW
                   (10) -->     BERTH4 IF VESSEL** EVESSEL** AT BERTH4 EQ 0  OW
                                BERTH5 IF VESSEL** EVESSEL** AT BERTH5 EQ 0  OW
                                BERTH6 IF VESSEL** EVESSEL** AT BERTH6 EQ 0  OW
                                WAIT
            ELEMENT BERTH1
                 VESSEL01 S EVESSEL01 + RULE NVAN01 VANORDER1 + RULE NCAR01 CARORDER1
                 VESSEL02 S EVESSEL02 + RULE NVAN02 VANORDER1 + RULE NCAR02 CARORDER1
                 VESSEL03 S EVESSEL03 + RULE NVAN03 VANORDER1 + RULE NCAR03 CARORDER1
                 VESSEL04 S EVESSEL04 + RULE NVAN04 VANORDER1 + RULE NCAR04 CARORDER1
                 VESSEL05 S EVESSEL05 + RULE NVAN05 VANORDER1 + RULE NCAR05 CARORDER1
                 VESSEL06 S EVESSEL06 + RULE NVAN06 VANORDER1 + RULE NCAR06 CARORDER1
                 VESSEL07 S EVESSEL07 + RULE NVAN07 VANORDER1 + RULE NCAR07 CARORDER1
                 VESSEL08 S EVESSEL08 + RULE NVAN08 VANORDER1 + RULE NCAR08 CARORDER1
                 VESSEL09 S EVESSEL09 + RULE NVAN09 VANORDER1 + RULE NCAR09 CARORDER1
                 VESSEL10 S EVESSEL10 + RULE NVAN10 VANORDER1 + RULE NCAR10 CARORDER1
            ==   VANORDER1 G    LONGTON1
            ==   CARORDER1 G 30 LONGTON1
            ==   LONGTON1 R 0
                 VANORDER1 R LOAD1 IF VANORDER1 AT LOAD1 EQ 0
                   AND EVESSEL** AT BERTH1 GT 0 AND CARGOTRA AT TRGATE     GT 0
                  OW WAIT
                 CARORDER1 R LOAD1 IF CARORDER1 AT LOAD1 EQ 0
                      AND EVESSEL** AT BERTH1 GT 0 AND CARGORRA AT FRGATE     GT 0
                            OW WAIT
                 EVESSEL01 T BERTH01
                 EVESSEL02 T BERTH02
                 EVESSEL03 T BERTH03
                 EVESSEL04 T BERTH04
                 EVESSEL05 T BERTH05
                 EVESSEL06 T BERTH06
                 EVESSEL07 T BERTH07
                 EVESSEL08 T BERTH08
                 EVESSEL09 T BERTH09
                 EVESSEL10 T BERTH10
                 (EVESSEL** + ALL ORTR1 + ALL ORRR1) C LVESSEL--
                 LVESSEL** R 0
            ELEMENT BERTH2
                 VESSEL01 S EVESSEL01 + RULE NVAN01 VANORDER2 + RULE NCAR01 CARORDER2
                 VESSEL02 S EVESSEL02 + RULE NVAN02 VANORDER2 + RULE NCAR02 CARORDER2
                 VESSEL03 S EVESSEL03 + RULE NVAN03 VANORDER2 + RULE NCAR03 CARORDER2
                 VESSEL04 S EVESSEL04 + RULE NVAN04 VANORDER2 + RULE NCAR04 CARORDER2
                 VESSEL05 S EVESSEL05 + RULE NVAN05 VANORDER2 + RULE NCAR05 CARORDER2
                 VESSEL06 S EVESSEL05 + RULE NVAN06 VANORDER2 + RULE NCAR06 CARORDER2
                 VESSEL07 S EVESSEL07 + RULE NVAN07 VANORDER2 + RULE NCAR07 CARORDER2
                 VESSEL08 S EVESSEL08 + RULE NVAN08 VANORDER2 + RULE NCAR08 CARORDER2
                 VESSEL09 S EVESSEL09 + RULE NVAN09 VANORDER2 + RULE NCAR09 CARORDER2
                 VESSEL10 S EVESSEL10 + RULE NVAN10 VANORDER2 + RULE NCAR10 CARORDER2
            ==   VANORDER2 G    LONGTON2
            ==   CARORDER2 G 30 LONGTON2
            ==   LONGTON2 R 0
```

Figure 11 - SAMPLE OPERATING RULES INPUT (CONT.)

NWS CONCORD EXPORT CAPABILITY

```
                         VANORDER2 R LOAD2 IF VANORDER2 AT LOAD2 EQ 0
                           AND EVESSEL** AT BERTH2 GT 0 AND CARGOTRA AT TRGATE     GT 0
                           OW WAIT
                         CARORDER2 R LOAD2 IF CARORDER2 AT LOAD2 EQ 0
                              AND EVESSEL** AT BERTH2 GT 0 AND CARGORRA AT RRGATE     GT 0
                              OW WAIT
                         EVESSEL01 T BERTH01
                         EVESSEL02 T BERTH02
                         EVESSEL03 T BERTH03
                         EVESSEL04 T BERTH04
                         EVESSEL05 T BERTH05
                         EVESSEL06 T BERTH06
                         EVESSEL07 T BERTH07
                         EVESSEL08 T BERTH08
                         EVESSEL09 T BERTH09
                         EVESSEL10 T BERTH10
                         (EVESSEL** + ALL ORTR2 + ALL ORRR2) C LVESSEL--
                         LVESSEL** R 0
               ELEMENT BERTH3
                         VESSEL01 S EVESSEL01 + RULE NVAN01 VANORDER3 + RULE NCAR01 CARORDER3
                         VESSEL02 S EVESSEL02 + RULE NVAN02 VANORDER3 + RULE NCAR02 CARORDER3
                         VESSEL03 S EVESSEL03 + RULE NVAN03 VANORDER3 + RULE NCAR03 CARORDER3
                         VESSEL04 S EVESSEL04 + RULE NVAN04 VANORDER3 + RULE NCAR04 CARORDER3
                         VESSEL05 S EVESSEL05 + RULE NVAN05 VANORDER3 + RULE NCAR05 CARORDER3
                         VESSEL06 S EVESSEL06 + RULE NVAN06 VANORDER3 + RULE NCAR06 CARORDER3
                         VESSEL07 S EVESSEL07 + RULE NVAN07 VANORDER3 + RULE NCAR07 CARORDER3
                         VESSEL08 S EVESSEL08 + RULE NVAN08 VANORDER3 + RULE NCAR08 CARORDER3
                         VESSEL09 S EVESSEL09 + RULE NVAN09 VANORDER3 + RULE NCAR09 CARORDER3
                         VESSEL10 S EVESSEL10 + RULE NVAN10 VANORDER3 + RULE NCAR10 CARORDER3
               ==        VANORDER3 G    LONGTON3
               ==        CARORDER3 G 30 LONGTON3
               ==        LONGTON3 R 0
                         VANORDER3 R LOAD3 IF VANORDER3 AT LOAD3 EQ 0
                              AND EVESSEL** AT BERTH3 GT 0 AND CARGOTRA AT TRGATE     GT 0
                              OW WAIT
                         CARORDER3 R LOAD3 IF CARORDER3 AT LOAD3 EQ 0
                              AND EVESSEL** AT BERTH3 GT 0 AND CARGORRA AT RRGATE     GT 0
                                OW WAIT
                         EVESSEL01 T BERTH01
                         EVESSEL02 T BERTH02
                         EVESSEL03 T BERTH03
                         EVESSEL04 T BERTH04
                         EVESSEL05 T BERTH05
                         EVESSEL06 T BERTH06
                         EVESSEL07 T BERTH07
                         EVESSEL08 T BERTH08
                         EVESSEL09 T BERTH09
                         EVESSEL10 T BERTH10
                         (EVESSEL** + ALL ORTR3 + ALL ORRR3) C LVESSEL--
                         LVESSEL** R 0
               ELEMENT BERTH4
```

Figure 12 - SAMPLE OPERATING RULES INPUT (CONT.)

NWS CONCORD EXPORT CAPABILITY

```
                            VESSEL01 S EVESSEL01 + RULE NVAN01 VANORDER4 + RULE NCAR01 CARORDER4
                            VESSEL02 S EVESSEL02 + RULE NVAN02 VANORDER4 + RULE NCAR02 CARORDER4
                            VESSEL03 S EVESSEL03 + RULE NVAN03 VANORDER4 + RULE NCAR03 CARORDER4
                            VESSEL04 S EVESSEL04 + RULE NVAN04 VANORDER4 + RULE NCAR04 CARORDER4
                            VESSEL05 S EVESSEL05 + RULE NVAN05 VANORDER4 + RULE NCAR05 CARORDER4
                            VESSEL06 S EVESSEL06 + RULE NVAN06 VANORDER4 + RULE NCAR06 CARORDER4
                            VESSEL07 S EVESSEL07 + RULE NVAN07 VANORDER4 + RULE NCAR07 CARORDER4
                            VESSEL08 S EVESSEL08 + RULE NVAN08 VANORDER4 + RULE NCAR08 CARORDER4
                            VESSEL09 S EVESSEL09 + RULE NVAN09 VANORDER4 + RULE NCAR09 CARORDER4
                            VESSEL10 S EVESSEL10 + RULE NVAN10 VANORDER4 + RULE NCAR10 CARORDER4
                    ==      VANORDER4 G    LONGTON4
                    ==      CARORDER4 G 30 LONGTON4
                    ==      LONGTON4 R 0
                            VANORDER4 R LOAD4 IF VANORDER4 AT LOAD4 EQ 0
                               AND EVESSEL** AT BERTH4 GT 0 AND CARGOTRA AT TRGATE    GT 0
                              OW WAIT
                            CARORDER4 R LOAD4 IF CARORDER4 AT LOAD4 EQ 0
                              AND EVESSEL** AT BERTH4 GT 0 AND CARGORRA AT RRGATE    GT 0
                                OW WAIT
                            EVESSEL01 T BERTH01
                            EVESSEL02 T BERTH02
                            EVESSEL03 T BERTH03
                            EVESSEL04 T BERTH04
                            EVESSEL05 T BERTH05
                            EVESSEL06 T BERTH06
                            EVESSEL07 T BERTH07
                            EVESSEL08 T BERTH08
                            EVESSEL09 T BERTH09
                            EVESSEL10 T BERTH10
                            (EVESSEL** + ALL ORTR4 + ALL ORRR4) C LVESSEL--
                            LVESSEL** R 0
                    ELEMENT BERTH5
                            VESSEL01 S EVESSEL01 + RULE NVAN01 VANORDER5 + RULE NCAR01 CARORDER5
                            VESSEL02 S EVESSEL02 + RULE NVAN02 VANORDER5 + RULE NCAR02 CARORDER5
                            VESSEL03 S EVESSEL03 + RULE NVAN03 VANORDER5 + RULE NCAR03 CARORDER5
                            VESSEL04 S EVESSEL04 + RULE NVAN04 VANORDER5 + RULE NCAR04 CARORDER5
                            VESSEL05 S EVESSEL05 + RULE NVAN05 VANORDER5 + RULE NCAR05 CARORDER5
                            VESSEL06 S EVESSEL06 + RULE NVAN06 VANORDER5 + RULE NCAR06 CARORDER5
                            VESSEL07 S EVESSEL07 + RULE NVAN07 VANORDER5 + RULE NCAR07 CARORDER5
                            VESSEL08 S EVESSEL08 + RULE NVAN08 VANORDER5 + RULE NCAR08 CARORDER5
                            VESSEL09 S EVESSEL09 + RULE NVAN09 VANORDER5 + RULE NCAR09 CARORDER5
                            VESSEL10 S EVESSEL10 + RULE NVAN10 VANORDER5 + RULE NCAR10 CARORDER5
                    ==      VANORDER5 G    LONGTON5
                    ==      CARORDER5 G 30 LONGTON5
                    ==      LONGTON5 R 0
                            VANORDER5 R LOAD5 IF VANORDER5 AT LOAD5 EQ 0
                               AND EVESSEL** AT BERTH5 GT 0 AND CARGOTRA AT TRGATE    GT 0
                               OW WAIT
                            CARORDER5 R LOAD5 IF CARORDER5 AT LOAD5 EQ 0
                              AND EVESSEL** AT BERTH5 GT 0 AND CARGORRA AT RRGATE    GT 0
                              OW WAIT
```

Figure 13 - SAMPLE OPERATING RULES INPUT (CONT.)

NWS CONCORD EXPORT CAPABILITY

```
                  EVESSEL01  T  BERTH01
                  EVESSEL02  T  BERTH02
                  EVESSEL03  T  BERTH03
                  EVESSEL04  T  BERTH04
                  EVESSEL05  T  BERTH05
                  EVESSEL06  T  BERTH06
                  EVESSEL07  T  BERTH07
                  EVESSEL08  T  BERTH08
                  EVESSEL09  T  BERTH09
                  EVESSEL10  T  BERTH10
                  (EVESSEL** + ALL ORTR5 + ALL ORRR5) C LVESSEL--
                  LVESSEL**  R 0
           ELEMENT BERTH6
                  VESSEL01 S EVESSEL01 + RULE NVAN01 VANORDER6 + RULE NCAR01 CARORDER6
                  VESSEL02 S EVESSEL02 + RULE NVAN02 VANORDER6 + RULE NCAR02 CARORDER6
                  VESSEL03 S EVESSEL03 + RULE NVAN03 VANORDER6 + RULE NCAR03 CARORDER6
                  VESSEL04 S EVESSEL04 + RULE NVAN04 VANORDER6 + RULE NCAR04 CARORDER6
                  VESSEL05 S EVESSEL05 + RULE NVAN05 VANORDER6 + RULE NCAR05 CARORDER6
                  VESSEL06 S EVESSEL06 + RULE NVAN06 VANORDER6 + RULE NCAR06 CARORDER6
                  VESSEL07 S EVESSEL07 + RULE NVAN07 VANORDER6 + RULE NCAR07 CARORDER6
                  VESSEL08 S EVESSEL08 + RULE NVAN08 VANORDER6 + RULE NCAR08 CARORDER6
                  VESSEL09 S EVESSEL09 + RULE NVAN09 VANORDER6 + RULE NCAR09 CARORDER6
                  VESSEL10 S EVESSEL10 + RULE NVAN10 VANORDER6 + RULE NCAR10 CARORDER6
           ==     VANORDER5 G    LONGTON6
           ==     CARORDER6 G 30 LONGTON6
           ==     LONGTON5 R 0
                  VANORDER6 R LOAD6 IF VANORDER6 AT LOAD6 EQ 0
                     AND EVESSEL** AT BERTH6 GT 0 AND CARGOTRA AT TRGATE     GT 0
                     OW WAIT
                  CARORDER6 R LOAD6 IF CARORDER5 AT LOAD6 EQ 0
                     AND EVESSEL** AT BERTH6 GT 0 AND CARGORRA AT RGATE      GT 0
                     OW WAIT
                  EVESSEL01  T  BERTH01
                  EVESSEL02  T  BERTH02
                  EVESSEL03  T  BERTH03
                  EVESSEL04  T  BERTH04
                  EVESSEL05  T  BERTH05
                  EVESSEL06  T  BERTH06
                  EVESSEL07  T  BERTH07
                  EVESSEL08  T  BERTH08
                  EVESSEL09  T  BERTH09
                  EVESSEL10  T  BERTH10
                  (EVESSEL** + ALL ORTR6 + ALL ORRR6) C LVESSEL--
                  LVESSEL**  R 0
           ELEMENT LOAD1
                  (VANORDER* + CARGOTRA) C ORTR-
                  (CARORDER* + CARGORRA) C ORRR-
                  CARGOTRA   T ORTR
                  CARGORRA   T ORRR
                  ORTR1 R BERTH1
                  ORRR1 R BERTH1
```

Figure 14 - SAMPLE OPERATING RULES INPUT (CONT.)

```
NWS CONCORD EXPORT CAPABILITY
          ELEMENT LOAD2
                   ALL C SAME AS LOAD1
                   ALL T SAME AS LOAD1
                   ALL G SAME AS LOAD1
                   ORTR2 R BERTH2
                   ORRR2 R BERTH2
          ELEMENT LOAD3
                   ALL C SAME AS LOAD1
                   ALL T SAME AS LOAD1
                   ALL G SAME AS LOAD1
                   ORTR3 R BERTH3
                   ORRR3 R BERTH3
          ELEMENT LOAD4
                   ALL C SAME AS LOAD1
                   ALL T SAME AS LOAD1
                   ALL G SAME AS LOAD1
                   ORTR4 R BERTH4
                   ORRR4 R BERTH4
          ELEMENT LOAD5
                   ALL C SAME AS LOAD1
                   ALL T SAME AS LOAD1
                   ALL G SAME AS LOAD1
                   ORTR5 R BERTH5
                   ORRR5 R BERTH5
          ELEMENT LOAD6
                   ALL C SAME AS LOAD1
                   ALL T SAME AS LOAD1
                   ALL G SAME AS LOAD1
                   ORTR6 R BERTH6
                   ORRR6 R BERTH6
 6        ELEMENT STORAGETR
                   CARGOTRA R TRGATE
          ==
          ==       CARGOTRA LOG YES
          ==
          ELEMENT TRGATE                                 CAP 1
                   CARGOTRA R LOAD1    IF VANORDER1 AT LOAD1 GT 0 AND
                                          CARGOTRA AT LOAD1 EQ 0 OW
                              LOAD2    IF VANORDER2 AT LOAD2 GT 0 AND
                                          CARGOTRA AT LOAD2 EQ 0 OW
                              LOAD3    IF VANORDER3 AT LOAD3 GT 0 AND
                                          CARGOTRA AT LOAD3 EQ 0 OW
                              LOAD4    IF VANORDER4 AT LOAD4 GT 0 AND
                                          CARGOTRA AT LOAD4 EQ 0 OW
                              LOAD5    IF VANORDER5 AT LOAD5 GT 0 AND
                                          CARGOTRA AT LOAD5 EQ 0 OW
                              LOAD6    IF VANORDER6 AT LOAD6 GT 0 AND
                                          CARGOTRA AT LOAD6 EQ 0 OW
                              WAIT
 3        ELEMENT STORAGERR
                   TRAIN S RULE NRR RAILCAR
```

Figure 15 - SAMPLE OPERATING RULES INPUT (CONT.)

```
NWS CONCORD EXPORT CAPABILITY
 3                             RAILCAR S CARGORRA
                               CARGORRA R RRGATE
                       ELEMENT RRGATE                                   CAP 1
                               CARGORRA R LOAD1     IF CARORDER1 AT LOAD1 GT 0 AND
                                                       CARGORRA AT LOAD1 EQ 0 OW
                                          LOAD2     IF CARORDER2 AT LOAD2 GT 0 AND
                                                       CARGORRA AT LOAD2 EQ 0 OW
                                          LOAD3     IF CARORDER3 AT LOAD3 GT 0 AND
                                                       CARGORRA AT LOAD3 EQ 0 OW
                                          LOAD4     IF CARORDER4 AT LOAD4 GT 0 AND
                                                       CARGORRA AT LOAD4 EQ 0 OW
                                          LOAD5     IF CARORDER5 AT LOAD5 GT 0 AND
                                                       CARGORRA AT LOAD5 EQ 0 OW
                                          LOAD6     IF CARORDER6 AT LOAD6 GT 0 AND
                                                       CARGORRA AT LOAD6 EQ 0 OW
                                        WAIT
 7                 == INTERARRIVAL TIME FOR A SHIP
                   TABLE TARVSH POISSON 57 HR
                   == INTERARRIVAL TIME FOR A TRUCK
 4                 TABLE TR15      POISSON 15 MIN
                   TABLE TR75      POISSON 75 MIN
                   TABLE TR45      POISSON 45 MIN
                   == INTERARRIVAL TIME FOR A TRAIN
 1                 TABLE TARRAIL SPIKE     25 P 0   50 P 1 DAY   25 P 2 DAY
                   == LOADING TIMES FOR TRUCK AND RAILCAR
                   TABLE    ORTR   TRIANGLE 0 P 50 MIN    90 MIN 130 MIN
                   TABLE    ORRR   TRIANGLE 0 P  14 HR     20 HR     26 HR
                   == MEAN TIME IN PORT FOR EACH CLASS OF VESSEL
                   TABLE BERTH01   TRIANGLE 0 P 103 HR 114.3 HR 125 HR
                   TABLE BERTH02   TRIANGLE 0 P 137 HR 152.5 HR 167 HR
 9                 TABLE BERTH03   TRIANGLE 0 P 165 HR 183.4 HR 201 HR
                   TABLE BERTH04   TRIANGLE 0 P 170 HR 189.2 HR 208 HR
                   TABLE BERTH05   TRIANGLE 0 P 184 HR 204.1 HR 224 HR
                   TABLE BERTH06   TRIANGLE 0 P 186 HR 206.1 HR 226 HR
                   TABLE BERTH07   TRIANGLE 0 P 190 HR 211.4 HR 232 HR
                   TABLE BERTH08   TRIANGLE 0 P 192 HR 213.7 HR 240 HR
                   TABLE BERTH09   TRIANGLE 0 P 198 HR 220.0 HR 280 HR
                   TABLE BERTH10   TRIANGLE 0 P 221 HR 245.5 HR 340 HR
```

Figure 16 - SAMPLE OPERATING RULES INPUT (CONT.)

APPENDIX C

INITIAL SITUATION IN THE MODEL

The model was provided an initial situation in order to have some operations in progress at the start of the simulation. Figure 15 is a sample of the initial situation provided to TRANSIM. The railcar and van storage areas had 500 railcars (that is, 50 x 10) and 150 vans respectively. Each berth had an empty vessel prepared to load. The vessel classes chosen were representative of those classes most often loaded at the port.

```
DAY 0 HR 8 MIN 0 EL STORAGERR TYPE CARGORRA UNITS  50
DAY 0 HR 8 MIN 0 EL STORAGETR TYPE CARGOTRA UNITS 150
DAY 0 HR 8 MIN 0 EL BERTH2    TYPE VESSEL05 UNITS   1
DAY 0 HR 8 MIN 0 EL BERTH3    TYPE VESSEL04 UNITS   1
DAY 0 HR 8 MIN 0 EL BERTH5    TYPE VESSEL06 UNITS   1
DAY 0 HR 8 MIN 0 EL BERTH1    TYPE VESSEL07 UNITS   1
DAY 0 HR 8 MIN 0 EL BERTH4    TYPE VESSEL03 UNITS   1
DAY 0 HR 8 MIN 0 EL BERTH6    TYPE VESSEL01 UNITS   1
DAY 0 HR 8 MIN 0 EL TRCRIG    TYPE TRUCKGEN
DAY 0 HR 8 MIN 0 EL HARBOR    TYPE SHIP       0 TARVSH
DAY 0 HR 8 MIN 0 EL STORAGERR TYPE TRAIN      0 TARRAIL
```

Figure 17 - INITIAL DATA IN THE MODEL

APPENDIX D

ITERATIVE PROCESS OF TRANSIM

This appendix provides a demonstration of the processes the computer followed during the simulation. The output shown has been extracted from one of the test runs used to verify the logic of the model. There were some errors in this test run and the reader, therefore, is cautioned to pay attention only to those portions described, which are accurate images of the model.

Items of interest are provided at the following event times:

15-14-51 A ship originates in the harbor and becomes a vessel (#60635) delayed in the harbor awaiting a berth because all berths are full.

15-18-11 A truck enters and immediately leaves the system because of its arrival between 1600 and 0800 hours.

15-18-53 A unit of railcars (#63187) completes consolidation with the current carorder (#59134). This completes the loading function of this unit at berth 4 and generates a completed order (NCRR #60625) at berth 4. At the same time the next carorder (59124) moves to the loading element element (MOVE 4) at berth 4 where it matches up with the current railcar cargo (CARGORRA #63137) from the RRGATE. Also the next railcar cargo (CARGORRA #60934) moves from storage to the RRGATE

awaiting the next carorder. (Author's note: in a later program "MOVE" was changed to "LOAD" to more accurately reflect the actual loading function being performed. The words have the same meaning throughout this portion of the extracted output.)

16- 8- 0 A train of 10 cars arrives, and becomes railcar cargo (CARGORRA) in storage.

16- 8-30 A truck arrives during receiving hours and becomes van cargo (CARGOTRA) which passes through the TRGATE to the loading (MOVE 3) function at berth 3 where it begins consolidation with the current vanorder. (In this case the truck storage area was empty of vans explaining why the van went immediately to a berth. If the van storage area was not depleted, the van would have been delayed in storage similar to the railcars arriving at 16- 8- 0.)

17- 0-21 The once empty class 8 vessel (#55903) at berth 1 consolidates all completed van (RRTR) and railcar (ORRR) shipments into a loaded vessel (#57153) and leaves the system. Then the class 1 vessel (#60635) moves from the harbor to berth 1 where it becomes an empty vessel with requirements for 3 vanorders and 1 carorder ready for matching with van and railcar cargo at the respective gates.

NWS CONCORD EXPORT CAPABILITY TEST RUN 1 - 06MAY77 PAGE 124

EVENT TIME DAY	HR	MIN	TRAFFIC UNIT TYPE	IDENT.	EVENT DESCRIPTION		ENTERED SERVICE DAY	HR	MIN	ENTERED DELAY DAY	HR	MN
15	14	24	VANORDER2	60108	MOVES FROM BERTH2	TO MOVE2	0	0	0	8	15	48
15	14	24	CARGOTRA	60645	MOVES FROM TRGATE	TO MOVE2	0	0	0	0	0	0
15	14	24	CARGOTRA	60645	BEGINS CONSOLIDATION	AT MOVE2	0	0	0	15	14	24
15	14	33	TRUCK	62437	ORIGINATES	AT TRORIG	0	0	0	0	0	0
15	14	33	TRUCK	62437	MOVES FROM TRORIG	TO STORAGETR	0	0	0	0	0	0
15	14	33	TRUCK	62437	SUBSTITUTES	AT STORAGETR	0	0	0	0	0	0
15	14	33	CARGOTRA	62437	ORIGINATES	AT STORAGETR	0	0	0	0	0	0
15	14	33	CARGOTRA	62437	MOVES FROM STORAGETR	TO TRGATE	0	0	0	0	0	0
15	14	33	CARGOTRA	62437	MOVES FROM TRGATE	TO MOVE3	0	0	0	0	0	0
15	14	33	CARGOTRA	62437	BEGINS CONSOLIDATION	AT MOVE3	0	0	0	15	14	33
15	14	40	VANORDER3	59514	BEGINS CONSOLIDATION	AT MOVE3	15	13	47	15	14	40
15	14	40	VANORDER3	59514	COMPLETES CONSOLIDATION	AT MOVE3	15	13	47	15	14	40
15	14	40	CARGOTRA	62437	COMPLETES CONSOLIDATION	AT MOVE3	0	0	0	15	14	33
15	14	40	ORTR3	57729	ORIGINATES	AT MOVE3	0	0	0	0	0	0
15	14	40	ORTR3	57729	MOVES FROM MOVE3	TO BERTH3	0	0	0	0	0	0
15	14	40	ORTR3	57729	BEGINS CONSOLIDATION	AT BERTH3	0	0	0	15	14	40
15	14	51	SHIP	60635	ORIGINATES	AT HARBOR	0	0	0	0	0	0
15	14	51	SHIP	60635	SUBSTITUTES	AT HARBOR	0	0	0	0	0	0
15	14	51	VESSEL01	60635	ORIGINATES	AT HARBOR	0	0	0	0	0	0
15	14	51	VESSEL01	60635	BEGINS DELAY	AT HARBOR	0	0	0	15	14	51
15	14	54	VANORDER1	61621	BEGINS CONSOLIDATION	AT MOVE1	15	13	47	15	14	54
15	14	54	VANORDER1	61621	COMPLETES CONSOLIDATION	AT MOVE1	15	13	47	15	14	54
15	14	54	CARGOTRA	73129	COMPLETES CONSOLIDATION	AT MOVE1	0	0	0	15	13	47
15	14	54	ORTR1	62107	ORIGINATES	AT MOVE1	0	0	0	0	0	0
15	14	54	ORTR1	62107	MOVES FROM MOVE1	TO BERTH1	0	0	0	0	0	0
15	14	54	ORTR1	62107	BEGINS CONSOLIDATION	AT BERTH1	0	0	0	15	14	54
15	16	3	VANORDER2	60108	BEGINS CONSOLIDATION	AT MOVE2	15	14	24	15	16	3
15	16	3	VANORDER2	60108	COMPLETES CONSOLIDATION	AT MOVE2	15	14	24	15	16	3
15	16	3	CARGOTRA	60645	COMPLETES CONSOLIDATION	AT MOVE2	0	0	0	15	14	24
15	16	3	ORTR2	57633	ORIGINATES	AT MOVE2	0	0	0	0	0	0
15	16	3	ORTR2	57633	MOVES FROM MOVE2	TO BERTH2	0	0	0	0	0	0
15	16	3	ORTR2	57633	BEGINS CONSOLIDATION	AT BERTH2	0	0	0	15	16	3
15	18	11	TRUCK	60625	ORIGINATES	AT TRORIG	0	0	0	0	0	0
15	18	11	TRUCK	60625	LEAVES SYSTEM	AT TRORIG	0	0	0	0	0	0
15	18	53	CARORDER4	59134	BEGINS CONSOLIDATION	AT MOVE4	14	5	51	15	18	53
15	18	53	CARORDER4	59134	COMPLETES CONSOLIDATION	AT MOVE4	14	5	51	15	18	53
15	18	53	CARGORRA	63187	COMPLETES CONSOLIDATION	AT MOVE4	0	0	0	14	5	51
15	18	53	ORRR4	60625	ORIGINATES	AT MOVE4	0	0	0	0	0	0
15	18	53	CARORDER4	59124	MOVES FROM BERTH4	TO MOVE4	0	0	0	0	16	11
15	18	53	CARGORRA	63137	MOVES FROM RRGATE	TO MOVE4	0	0	0	15	13	11
15	18	53	CARGORRA	60314	MOVES FROM STORAGERR	TO RRGATE	0	0	0	0	8	0
15	18	53	ORRR4	60625	MOVES FROM MOVE4	TO BERTH4	0	0	0	0	0	0
15	18	53	CARGORRA	63137	BEGINS CONSOLIDATION	AT MOVE4	0	0	0	15	18	53
15	18	53	CARGORRA	60334	BEGINS DELAY	AT RRGATE	0	0	0	15	18	53
15	18	53	ORRR4	60625	BEGINS CONSOLIDATION	AT BERTH4	0	0	0	15	18	53
15	21	18	TRUCK	62387	ORIGINATES	AT TRORIG	0	0	0	0	0	0
15	21	18	TRUCK	62387	LEAVES SYSTEM	AT TRORIG	0	0	0	0	0	0

Figure 18 - SAMPLE TRANSIM ITERATIONS

NWS CONCORD EXPORT CAPABILITY   TEST RUN 1 - 06MAY77   PAGE 125

EVENT TIME DAY	HR	MIN	TRAFFIC UNIT TYPE	IDENT.	EVENT DESCRIPTION		ENTERED SERVICE DAY	HR	MIN	ENTERED DELAY DAY	HR	MN
15	21	45	TRUCK	62337	ORIGINATES	AT TRORIG	0	0	0	0	0	0
15	21	45	TRUCK	62337	LEAVES SYSTEM	AT TRORIG	0	0	0	0	0	0
15	23	29	TRUCK	62307	ORIGINATES	AT TRORIG	0	0	0	0	0	0
15	23	29	TRUCK	62317	LEAVES SYSTEM	AT TRORIG	0	0	0	0	0	0
16	0	19	TRUCK	62307	ORIGINATES	AT TRORIG	0	0	0	0	0	0
16	0	19	TRUCK	62337	LEAVES SYSTEM	AT TRORIG	0	0	0	0	0	0
16	0	48	CARTRDERS	56139	BEGINS CONSOLIDATION	AT MOVES	14	4	36	16	0	48
16	0	48	CARBRDERS	56139	COMPLETES CONSOLIDATION	AT MOVES	14	4	36	16	0	48
16	0	48	CARGORRA	63137	COMPLETES CONSOLIDATION	AT MOVES	0	0	0	14	4	36
16	0	48	BRRRS	62337	ORIGINATES	AT MOVES	0	0	0	0	0	0
16	0	48	CARBRDERS	56127	MOVES FROM BERTHS	TO MOVES	0	0	0	6	9	41
16	0	48	CARGORRA	60934	MOVES FROM RRGATE	TO MOVES	0	0	0	15	18	53
16	0	48	CARGORRA	53550	MOVES FROM STORAGERR	TO RRGATE	0	0	0	1	8	0
16	0	48	BRERS	62337	MOVES FROM MOVES	TO BERTHS	0	0	0	0	0	0
16	0	48	CARGORRA	60934	BEGINS CONSOLIDATION	AT MOVES	0	0	0	16	0	48
16	0	48	CARGORRA	53550	BEGINS DELAY	AT RRGATE	0	0	0	16	0	48
16	0	48	BERRS	62337	BEGINS CONSOLIDATION	AT BERTHS	0	0	0	16	0	48
16	3	11	TRUCK	57333	ORIGINATES	AT TRORIG	0	0	0	0	0	0
16	3	11	TRUCK	57333	LEAVES SYSTEM	AT TRORIG	0	0	0	0	0	0
16	4	57	SHIP	57333	ORIGINATES	AT HARBOR	0	0	0	0	0	0
16	4	57	SHIP	57393	SUBSTITUTES	AT HARBOR	0	0	0	0	0	0
16	4	57	VESSEL06	57333	ORIGINATES	AT HARBOR	0	0	0	0	0	0
16	4	57	VESSEL06	57393	BEGINS DELAY	AT HARBOR	0	0	0	16	4	57
16	6	53	TRUCK	60615	ORIGINATES	AT TRORIG	0	0	0	0	0	0
16	6	53	TRUCK	60615	LEAVES SYSTEM	AT TRORIG	0	0	0	0	0	0
16	7	1	TRUCK	60615	ORIGINATES	AT TRORIG	0	0	0	0	0	0
16	7	1	TRUCK	60615	LEAVES SYSTEM	AT TRORIG	0	0	0	0	0	0
16	8	0	TRAIN	60615	ORIGINATES	AT STORAGERR	0	0	0	0	0	0
16	8	0	TRAIN	60615	SUBSTITUTES	AT STORAGERR	0	0	0	0	0	0
16	8	0	RAILCAR	60615	ORIGINATES	AT STORAGERR	0	0	0	0	0	0
16	8	0	RAILCAR	60615	SUBSTITUTES	AT STORAGERR	0	0	0	0	0	0
16	8	0	CARGORRA	60615	ORIGINATES	AT STORAGERR	0	0	0	0	0	0
16	8	0	CARGORRA	60615	BEGINS DELAY	AT STORAGERR	0	0	0	16	8	0
16	8	11	TRUCK	62367	ORIGINATES	AT TRORIG	0	0	0	0	0	0
16	8	11	TRUCK	62367	MOVES FROM TRORIG	TO STORAGETR	0	0	0	0	0	0
16	8	11	TRUCK	62367	SUBSTITUTES	AT STORAGETR	0	0	0	0	0	0
16	8	11	CARGOTRA	62367	ORIGINATES	AT STORAGETR	0	0	0	0	0	0
16	8	11	CARGOTRA	62367	MOVES FROM STORAGETR	TO TRGATE	0	0	0	0	0	0
16	8	11	VANORDER1	63017	MOVES FROM BERTH1	TO MOVE1	0	0	0	7	16	23
16	8	11	VANORDER2	62037	MOVES FROM BERTH2	TO MOVE2	0	0	0	8	15	48
16	8	11	VANORDER3	62087	MOVES FROM BERTH3	TO MOVE3	0	0	0	10	2	27
16	8	11	CARGOTRA	62367	MOVES FROM TRGATE	TO MOVE1	0	0	0	0	0	0
16	8	11	CARGOTRA	62367	BEGINS CONSOLIDATION	AT MOVE1	0	0	0	16	8	11
16	8	19	TRUCK	57297	ORIGINATES	AT TRORIG	0	0	0	0	0	0
16	8	19	TRUCK	57297	MOVES FROM TRORIG	TO STORAGETR	0	0	0	0	0	0
16	8	19	TRUCK	57297	SUBSTITUTES	AT STORAGETR	0	0	0	0	0	0
16	8	19	CARGOTRA	57297	ORIGINATES	AT STORAGETR	0	0	0	0	0	0

Figure 19 - SAMPLE TRANSIM ITERATIONS (CONT.)

NWS CONCORD EXPORT CAPABILITY — TEST RUN 1 - 30MAY77 — PAGE 126

EVENT TIME DAY HR MIN	TRAFFIC UNIT TYPE	IDENT.	EVENT DESCRIPTION		ENTERED SERVICE DAY HR MIN	ENTERED DELAY DAY HR MN
16 8 19	CARGOTRA	57297	MOVES FROM STORAGETR	TO TRGATE	0 0 0	0 0 0
16 8 19	CARGOTRA	57297	MOVES FROM TRGATE	TO MOVE2	0 0 0	0 0 0
16 8 19	CARGOTRA	57297	BEGINS CONSOLIDATION	AT MOVE2	0 0 0	16 8 19
16 8 30	TRUCK	60605	ORIGINATES	AT TRORIG	0 0 0	0 0 0
16 8 30	TRUCK	60605	MOVES FROM TRORIG	TO STORAGETR	0 0 0	0 0 0
16 8 30	TRUCK	60605	SUBSTITUTES	AT STORAGETR	0 0 0	0 0 0
16 8 30	CARGOTRA	60605	ORIGINATES	AT STORAGETR	0 0 0	0 0 0
16 8 30	CARGOTRA	60605	MOVES FROM STORAGETR	TO TRGATE	0 0 0	0 0 0
16 8 30	CARGOTRA	60605	MOVES FROM TRGATE	TO MOVE3	0 0 0	0 0 0
16 8 30	CARGOTRA	60605	BEGINS CONSOLIDATION	AT MOVE3	0 0 0	16 8 30
16 8 41	TRUCK	62337	ORIGINATES	AT TRORIG	0 0 0	0 0 0
16 8 41	TRUCK	62317	MOVES FROM TRORIG	TO STORAGETR	0 0 0	0 0 0
16 8 41	TRUCK	62317	SUBSTITUTES	AT STORAGETR	0 0 0	0 0 0
16 8 41	CARGOTRA	62317	ORIGINATES	AT STORAGETR	0 0 0	0 0 0
16 8 41	CARGOTRA	62337	MOVES FROM STORAGETR	TO TRGATE	0 0 0	0 0 0
16 8 41	CARGOTRA	62337	MOVES FROM TRGATE	TO MOVE4	0 0 0	0 0 0
16 8 41	CARGOTRA	62337	BEGINS CONSOLIDATION	AT MOVE4	0 0 0	16 8 41
16 8 41	VANORDER4	57345	COMPLETES CONSOLIDATION	AT MOVE4	11 8 57	11 10 42
16 8 41	CARGOTRA	62337	COMPLETES CONSOLIDATION	AT MOVE4	0 0 0	16 8 41
16 8 41	ORTR4	56721	ORIGINATES	AT MOVE4	0 0 0	0 0 0
16 8 41	ORTR4	56721	MOVES FROM MOVE4	TO BERTH4	0 0 0	0 0 0
16 8 41	ORTR4	56721	BEGINS CONSOLIDATION	AT BERTH4	0 0 0	16 8 41
16 9 41	VANORDER1	63017	BEGINS CONSOLIDATION	AT MOVE1	16 8 11	16 9 41
16 9 41	VANORDER1	63017	COMPLETES CONSOLIDATION	AT MOVE1	16 8 11	16 9 41
16 9 41	CARGOTRA	62367	COMPLETES CONSOLIDATION	AT MOVE1	0 0 0	16 8 11
16 9 41	ORTR1	57261	ORIGINATES	AT MOVE1	0 0 0	0 0 0
16 9 41	ORTR1	57261	MOVES FROM MOVE1	TO BERTH1	0 0 0	0 0 0
16 9 41	ORTR1	57261	BEGINS CONSOLIDATION	AT BERTH1	0 0 0	16 9 41
16 10 0	VANORDER2	62037	BEGINS CONSOLIDATION	AT MOVE2	16 8 11	16 10 0
16 10 0	VANORDER2	62037	COMPLETES CONSOLIDATION	AT MOVE2	16 8 11	16 10 0
16 10 0	CARGOTRA	57297	COMPLETES CONSOLIDATION	AT MOVE2	0 0 0	16 8 19
16 10 0	ORTR2	60595	ORIGINATES	AT MOVE2	0 0 0	0 0 0
16 10 0	ORTR2	60595	MOVES FROM MOVE2	TO BERTH2	0 0 0	0 0 0
16 10 0	ORTR2	60595	BEGINS CONSOLIDATION	AT BERTH2	0 0 0	16 10 0
16 10 4	VANORDER3	62687	BEGINS CONSOLIDATION	AT MOVE3	16 8 11	16 10 4
16 10 4	VANORDER3	62687	COMPLETES CONSOLIDATION	AT MOVE3	16 8 11	16 10 4
16 10 4	CARGOTRA	60605	COMPLETES CONSOLIDATION	AT MOVE3	0 0 0	16 8 30
16 10 4	ORTR3	62317	ORIGINATES	AT MOVE3	0 0 0	0 0 0
16 10 4	ORTR3	62317	MOVES FROM MOVE3	TO BERTH3	0 0 0	0 0 0
16 10 4	ORTR3	62317	BEGINS CONSOLIDATION	AT BERTH3	0 0 0	16 10 4
16 15 7	TRUCK	57225	ORIGINATES	AT TRORIG	0 0 0	0 0 0
16 15 7	TRUCK	57225	MOVES FROM TRORIG	TO STORAGETR	0 0 0	0 0 0
16 15 7	TRUCK	57225	SUBSTITUTES	AT STORAGETR	0 0 0	0 0 0
16 15 7	CARGOTRA	57225	ORIGINATES	AT STORAGETR	0 0 0	0 0 0
16 15 7	CARGOTRA	57225	MOVES FROM STORAGETR	TO TRGATE	0 0 0	0 0 0
16 15 7	VANORDER1	60905	MOVES FROM BERTH1	TO MOVE1	0 0 0	7 16 23
16 15 7	VANORDER2	63007	MOVES FROM BERTH2	TO MOVE2	0 0 0	8 15 48

Figure 20 - SAMPLE TRANSIM ITERATIONS (CONT.)

NWS CONCORD EXPORT CAPABILITY TEST RUN 1 - 06MAY77 PAGE 127

EVENT TIME DAY	HR	MIN	TRAFFIC UNIT TYPE	IDENT.	EVENT DESCRIPTION		ENTERED SERVICE DAY	HR	MIN	ENTERED DELAY DAY	HR	MN
16	15	7	VANORDER3	59668	MOVES FROM BERTH3	TO MOVE3	0	0	0	10	2	27
16	15	7	VANORDER4	59334	MOVES FROM BERTH4	TO MOVE4	0	0	0	10	20	37
16	15	7	CARGOTRA	57225	MOVES FROM TRGATE	TO MOVE1	0	0	0	0	0	0
16	15	7	CARGOTRA	57225	BEGINS CONSOLIDATION	AT MOVE1	0	0	0	16	15	7
16	15	9	TRUCK	60585	ORIGINATES	AT TRORIG	0	0	0	0	0	0
16	15	9	TRUCK	60585	MOVES FROM TRORIG	TO STORAGETR	0	0	0	0	0	0
16	15	9	TRUCK	60585	SUBSTITUTES	AT STORAGETR	0	0	0	0	0	0
16	15	9	CARGOTRA	60585	ORIGINATES	AT STORAGETR	0	0	0	0	0	0
16	15	9	CARGOTRA	60585	MOVES FROM STORAGETR	TO TRGATE	0	0	0	0	0	0
16	15	9	CARGOTRA	60585	MOVES FROM TRGATE	TO MOVE2	0	0	0	0	0	0
16	15	9	CARGOTRA	60585	BEGINS CONSOLIDATION	AT MOVE2	0	0	0	16	15	9
16	15	51	CARORDER3	60335	BEGINS CONSOLIDATION	AT MOVE3	15	1	26	16	15	51
16	15	51	CARORDER3	60335	COMPLETES CONSOLIDATION	AT MOVE3	15	1	26	16	15	51
16	15	51	CARGORRA	63177	COMPLETES CONSOLIDATION	AT MOVE3	0	0	0	15	1	26
16	15	51	ORRR3	62297	ORIGINATES	AT MOVE3	0	0	0	0	0	0
16	15	51	CARORDER3	60325	MOVES FROM BERTH3	TO MOVE3	0	0	0	0	8	25
16	15	51	CARGORRA	58561	MOVES FROM RRGATE	TO MOVE3	0	0	0	16	0	48
16	15	51	CARGORRA	57105	MOVES FROM STORAGERR	TO RRGATE	0	0	0	2	8	0
16	15	51	ORRR3	62297	MOVES FROM MOVE3	TO BERTH3	0	0	0	0	0	0
16	15	51	CARGORRA	58561	BEGINS CONSOLIDATION	AT MOVE3	0	0	0	16	15	51
16	15	51	CARGORRA	57105	BEGINS DELAY	AT RRGATE	0	0	0	16	15	51
16	15	51	ORRR3	62297	BEGINS CONSOLIDATION	AT BERTH3	0	0	0	16	15	51
16	16	2	CARORDER2	61767	BEGINS CONSOLIDATION	AT MOVE2	15	3	33	16	16	2
16	16	2	CARORDER2	61767	COMPLETES CONSOLIDATION	AT MOVE2	15	3	33	16	16	2
16	16	2	CARGORRA	63167	COMPLETES CONSOLIDATION	AT MOVE2	0	0	0	15	3	33
16	16	2	ORRR2	57201	ORIGINATES	AT MOVE2	0	0	0	0	0	0
16	16	2	CARORDER2	62107	MOVES FROM BERTH2	TO MOVE2	0	0	0	8	15	48
16	16	2	CARGORRA	57105	MOVES FROM RRGATE	TO MOVE2	0	0	0	16	15	51
16	16	2	CARGORRA	56799	MOVES FROM STORAGERR	TO RRGATE	0	0	0	3	8	0
16	16	2	ORRR2	57201	MOVES FROM MOVE2	TO BERTH2	0	0	0	0	0	0
16	16	2	CARGORRA	57105	BEGINS CONSOLIDATION	AT MOVE2	0	0	0	16	16	2
16	16	2	CARGORRA	56799	BEGINS DELAY	AT RRGATE	0	0	0	16	16	2
16	16	2	ORRR2	57201	BEGINS CONSOLIDATION	AT BERTH2	0	0	0	16	16	2
16	16	26	VANORDER1	60005	BEGINS CONSOLIDATION	AT MOVE1	16	15	7	16	16	26
16	16	26	VANORDER1	60005	COMPLETES CONSOLIDATION	AT MOVE1	16	15	7	16	16	26
16	16	26	CARGOTRA	57225	COMPLETES CONSOLIDATION	AT MOVE1	0	0	0	16	15	7
16	16	26	ORTR1	60575	ORIGINATES	AT MOVE1	0	0	0	0	0	0
16	16	26	ORTR1	60575	MOVES FROM MOVE1	TO BERTH1	0	0	0	0	0	0
16	16	26	ORTR1	60575	BEGINS CONSOLIDATION	AT BERTH1	0	0	0	16	16	26
16	16	31	VANORDER4	59334	BEGINS CONSOLIDATION	AT MOVE4	16	15	7	16	16	31
16	16	39	VANORDER3	59668	BEGINS CONSOLIDATION	AT MOVE3	16	15	7	16	16	39
16	16	47	VANORDER2	63007	BEGINS CONSOLIDATION	AT MOVE2	16	15	7	16	16	47
16	16	47	VANORDER2	63007	COMPLETES CONSOLIDATION	AT MOVE2	16	15	7	16	16	47
16	16	47	CARGOTRA	60585	COMPLETES CONSOLIDATION	AT MOVE2	0	0	0	16	15	9
16	16	47	ORTR2	60565	ORIGINATES	AT MOVE2	0	0	0	0	0	0
16	16	47	ORTR2	60565	MOVES FROM MOVE2	TO BERTH2	0	0	0	0	0	0
16	16	47	ORTR2	60565	BEGINS CONSOLIDATION	AT BERTH2	0	0	0	16	16	47

Figure 21 - SAMPLE TRANSIM ITERATIONS (CONT.)

NAS CONCORD EXPORT CAPABILITY   TEST RUN 1 - 06MAY77   PAGE 128

EVENT TIME DAY HR MIN			TRAFFIC UNIT TYPE	IDENT.	EVENT DESCRIPTION		ENTERED SERVICE DAY	HR	MIN	ENTERED DELAY DAY	HR	MN
16	22	8	CARORDERG	59061	BEGINS CONSOLIDATION	AT MOVEG	15	7	6	16	22	8
16	22	8	CARORDERG	59061	COMPLETES CONSOLIDATION	AT MOVEG	15	7	6	16	22	8
16	22	8	CARGORRA	63157	COMPLETES CONSOLIDATION	AT MOVEG	0	0	0	15	7	6
16	22	8	ORERG	62257	ORIGINATES	AT MOVEG	0	0	0	0	0	0
16	22	8	CARORDERG	60733	MOVES FROM BERTHG	TO MOVEG	0	0	0	12	4	28
16	22	8	CARGORRA	56793	MOVES FROM RRGATE	TO MOVEG	0	0	0	16	16	2
16	22	8	CARGORRA	56709	MOVES FROM STORAGERR	TO RRGATE	0	0	0	4	8	0
16	22	8	ORRRG	62257	MOVES FROM MOVEG	TO BERTHG	0	0	0	0	0	0
16	22	8	CARGORRA	56793	BEGINS CONSOLIDATION	AT MOVEG	0	0	0	16	22	8
16	22	8	CARGORRA	56709	BEGINS DELAY	AT RRGATE	0	0	0	16	22	8
16	22	8	ORRRG	62257	BEGINS CONSOLIDATION	AT BERTHG	0	0	0	16	22	8
16	23	10	TRUCK	57153	ORIGINATES	AT TRUCKIG	0	0	0	0	0	0
16	23	10	TRUCK	57153	LEAVES SYSTEM	AT TRUCKIG	0	0	0	0	0	0
17	0	21	EVESSEL08	55333	BEGINS CONSOLIDATION	AT BERTH1	7	16	23	17	0	21
17	0	21	EVESSEL08	55303	COMPLETES CONSOLIDATION	AT BERTH1	7	16	23	17	0	21
17	0	21	ORTRI	55337	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	8	10	9
17	0	21	ORTRI	63127	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	8	12	55
17	0	21	ORTRI	62337	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	8	14	19
17	0	21	ORTRI	62747	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	8	16	18
17	0	21	ORTRI	59563	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	9	11	24
17	0	21	ORTRI	62707	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	9	13	28
17	0	21	ORTRI	59534	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	9	16	3
17	0	21	ORTRI	62377	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	10	10	8
17	0	21	ORTRI	74865	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	11	10	35
17	0	21	ORTRI	56503	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	11	12	43
17	0	21	ORTRI	60745	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	12	11	10
17	0	21	ORTRI	62647	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	13	12	24
17	0	21	ORTRI	60705	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	13	14	41
17	0	21	ORTRI	62537	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	13	16	13
17	0	21	ORTRI	60055	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	14	12	17
17	0	21	ORTRI	60555	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	14	15	42
17	0	21	ORTRI	72430	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	15	9	55
17	0	21	ORTRI	62367	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	15	12	59
17	0	21	ORTRI	62107	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	15	14	54
17	0	21	ORTRI	57251	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	16	9	41
17	0	21	ORTRI	60575	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	16	16	26
17	0	21	ORRRI	60183	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	9	5	54
17	0	21	ORRRI	56343	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	10	22	31
17	0	21	ORRRI	62517	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	12	9	15
17	0	21	ORRRI	60785	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	13	20	12
17	0	21	ORRRI	55149	COMPLETES CONSOLIDATION	AT BERTH1	0	0	0	15	13	11
17	0	21	EVESSEL08	57153	ORIGINATES	AT BERTH1	0	0	0	0	0	0
17	0	21	VESSEL01	60533	MOVES FROM HARBOR	TO BERTH1	0	0	0	15	14	51
17	0	21	EVESSEL08	57153	LEAVES SYSTEM	AT BERTH1	0	0	0	0	0	0
17	0	21	VESSEL01	60033	SUBSTITUTES	AT BERTH1	0	0	0	0	0	0
17	0	21	EVESSEL01	60513	ORIGINATES	AT BERTH1	0	0	0	0	0	0
17	0	21	VANORDER1	57153	ORIGINATES	AT BERTH1	0	0	0	0	0	0

Figure 22 - SAMPLE TRANSIM ITERATIONS (CONT.)

NWS CONCORD EXPORT CAPABILITY — TEST RUN 1 - 06MAY77 — PAGE 129

EVENT TIME DAY HR MIN	TRAFFIC UNIT TYPE	IDENT.	EVENT DESCRIPTION	ENTERED SERVICE DAY HR MIN	ENTERED DELAY DAY HR MN
17 0 21	VANORDER1	55703	ORIGINATES AT BERTH1	0 0 0	0 0 0
17 0 21	VANORDER1	55583	ORIGINATES AT BERTH1	0 0 0	0 0 0
17 0 21	CARORDER1	55763	ORIGINATES AT BERTH1	0 0 0	0 0 0
17 0 21	VANORDER1	57153	BEGINS DELAY AT BERTH1	0 0 0	17 0 21
17 0 21	VANORDER1	55703	BEGINS DELAY AT BERTH1	0 0 0	17 0 21
17 0 21	VANORDER1	55583	BEGINS DELAY AT BERTH1	0 0 0	17 0 21
17 0 21	CARORDER1	55763	BEGINS DELAY AT BERTH1	0 0 0	17 0 21
17 1 44	TRUCK	55593	ORIGINATES AT TRORIG	0 0 0	0 0 0
17 1 44	TRUCK	55593	LEAVES SYSTEM AT TRORIG	0 0 0	0 0 0
17 2 31	CARORDER4	59124	BEGINS CONSOLIDATION AT MOVE4	15 18 53	17 2 31
17 2 31	CARORDER4	59124	COMPLETES CONSOLIDATION AT MOVE4	15 18 53	17 2 31
17 2 31	CARGORRA	63137	COMPLETES CONSOLIDATION AT MOVE4	0 0 0	15 18 53
17 2 31	ORRR4	55597	ORIGINATES AT MOVE4	0 0 0	0 0 0
17 2 31	CARORDER4	59114	MOVES FROM BERTH4 TO MOVE4	0 0 0	0 16 11
17 2 31	CARGORRA	56733	MOVES FROM RRGATE TO MOVE4	0 0 0	16 22 8
17 2 31	CARGORRA	56345	MOVES FROM STORAGERR TO RRGATE	0 0 0	5 8 0
17 2 31	ORRR4	55599	MOVES FROM MOVE4 TO BERTH4	0 0 0	0 0 0
17 2 31	CARGORRA	56703	BEGINS CONSOLIDATION AT MOVE4	0 0 0	17 2 31
17 2 31	CARGORRA	56745	BEGINS DELAY AT RRGATE	0 0 0	17 2 31
17 2 31	ORRR4	55579	BEGINS CONSOLIDATION AT BERTH4	0 0 0	17 2 31
17 3 14	TRUCK	63127	ORIGINATES AT TRORIG	0 0 0	0 0 0
17 3 14	TRUCK	63127	LEAVES SYSTEM AT TRORIG	0 0 0	0 0 0
17 4 41	TRUCK	63127	ORIGINATES AT TRORIG	0 0 0	0 0 0
17 4 41	TRUCK	63127	LEAVES SYSTEM AT TRORIG	0 0 0	0 0 0
17 6 52	SHIP	63127	ORIGINATES AT HARBOR	0 0 0	0 0 0
17 6 52	SHIP	63127	SUBSTITUTES AT HARBOR	0 0 0	0 0 0
17 6 52	VESSEL08	63127	ORIGINATES AT HARBOR	0 0 0	0 0 0
17 6 52	VESSEL08	63127	BEGINS DELAY AT HARBOR	0 0 0	17 6 52
17 8 0	TRAIN	61737	ORIGINATES AT STORAGERR	0 0 0	0 0 0
17 8 0	TRAIN	61737	SUBSTITUTES AT STORAGERR	0 0 0	0 0 0
17 8 0	RAILCAR	61737	ORIGINATES AT STORAGERR	0 0 0	0 0 0
17 8 0	RAILCAR	61737	SUBSTITUTES AT STORAGERR	0 0 0	0 0 0
17 8 0	CARGORRA	61737	ORIGINATES AT STORAGERR	0 0 0	0 0 0
17 8 0	CARGORRA	61737	BEGINS DELAY AT STORAGERR	0 0 0	17 8 0
17 8 33	TRUCK	61460	ORIGINATES AT TRORIG	0 0 0	0 0 0
17 8 33	TRUCK	61460	MOVES FROM TRORIG TO STORAGETR	0 0 0	0 0 0
17 8 33	TRUCK	61460	SUBSTITUTES AT STORAGETR	0 0 0	0 0 0
17 8 33	CARGOTRA	61460	ORIGINATES AT STORAGETR	0 0 0	0 0 0
17 8 33	CARGOTRA	61460	MOVES FROM STORAGETR TO TRGATE	0 0 0	0 0 0
17 8 33	VANORDER1	61611	MOVES FROM BERTH1 TO MOVE1	0 0 0	7 16 23
17 8 33	VANORDER2	59987	MOVES FROM BERTH2 TO MOVE2	0 0 0	8 15 48
17 8 33	CARGOTRA	61460	MOVES FROM TRGATE TO MOVE1	0 0 0	0 0 0
17 8 33	CARGOTRA	61460	BEGINS CONSOLIDATION AT MOVE1	0 0 0	17 8 33
17 9 15	CARORDER1	55691	BEGINS CONSOLIDATION AT MOVE1	15 13 11	17 9 15
17 9 15	CARORDER1	55699	COMPLETES CONSOLIDATION AT MOVE1	15 13 11	17 9 15
17 9 15	CARGORRA	63147	COMPLETES CONSOLIDATION AT MOVE1	0 0 0	15 13 11
17 9 15	ORRR1	62037	ORIGINATES AT MOVE1	0 0 0	0 0 0

Figure 23 - SAMPLE TRANSIM ITERATIONS (CONT.)

APPENDIX E

RESULTS OF SIMULATION RUN I

Simulation run I was run attempting to achieve 62.5 percent berth occupancy. The vessels arrivals were Poisson distributed with a mean interarrival time of 57 hours in order to generate about 76 vessels in the 180 day period.

Train arrivals were given a distribution of no trains arriving 25 percent of the days, one train 50 percent of the days, and two train trains arriving 25 percent of the days. Arriving trains had 30 cars 50 percent of the time and 40 cars the remainder of the time. Therefore, on the average, 35 railcars arrived each day.

Truck arrivals were Poisson distributed with a mean interarrival time of 45 minutes. The average number of truck arrivals per eight hour receiving period was expected to be 10.6.

The results for Simulation run I are shown in the accompanying figures and are summarized as follows:

1) Occupancy rate was 3.16/6 = 52.7 percent.

2) Van cargo exported was (1650)(18) = 29700 long tons.

3) Rail cargo exported was (547)(540) = 325080 long tons.

4) Total cargo exported was 325080 +29700 = 354,780 long tons.

5) Number of vessels turned around was 69.

6) Percent of vessels delayed was 100 - 87.9 = 12.1

percent.

7) Average/maximum number of vans in the storage area was 177.0/345.

8) Average van storage time was about 366.0 hours.

9) Average/maximum number of railcars in the storage area was 722/1420.

10) Average railcar storage time was about 454.3 hours.

NWS CONCORD EXPORT CAPABILITY SIX MONTH 13MAY77

SUMMARY 1.

OCCUPANCY OF ALL BERTHS (TOTAL NUMBER OF SHIPS IN PORT)

NUMBER IN SERVICE

TOTAL NUMBER IN REPORT PERIOD 69

MAXIMUM 6 (ON DAY [illegible] AT [illegible].
AND 12 OTHER TIMES)

AVERAGE 3.16

MINIMUM (ON DAY [illegible] AT [illegible].
AND 5 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
	2.9
1 THRU 1	15.3
2 THRU 2	23.4
3 THRU 3	11.7
4 THRU 4	2[illegible].2
5 THRU 5	13.3
6 THRU 6	11.3
OVER 6	[illegible]

Figure 24 - OCCUPANCY OF ALL BERTHS (SIM. I)

```
NWS CONCORD EXPORT CAPABILITY                 SIX MONTH

SUMMARY 13
          TOTAL RAIL   CARGO EXPORTED (UNITS OF 540 LONGTONS)


          TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

            TOTAL NUMBER IN REPORT PERIOD          547
            MAXIMUM      43 (ON DAY          7 AT 1046,
                            AND          2 OTHER TIMES)
            AVERAGE      10.63
            MINIMUM       0 (ON DAY          0 AT    0,
                            AND          2 OTHER TIMES)

                 NUMBER    PERCENT OF REPORT PERIOD
                   0                   2.0
                 1 THRU 100           98.0
               101 THRU 200            0.0
               201 THRU 300            0.0
               301 THRU 400            0.0
               401 THRU 500            0.0
               501 THRU 600            0.0
               601 THRU 700            0.0
               701 THRU 800            0.0
               801 THRU 900            0.0
               901 THRU1000            0.0
                   OVER1000            0.0
```

Figure 25 - TOTAL TRUCK CARGO EXPORTED (SIM. I)

NWS CONCORD EXPORT CAPABILITY SIX MONTH

SUMMARY 12
TOTAL TRUCK CARGO EXPORTED (UNITS OF 18 LONGTON)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 165[illegible]
MAXIMUM 1[illegible] (ON DAY 6 AT 1121)
AVERAGE [illegible]1.1[illegible]
MINIMUM [illegible] (ON DAY [illegible] AT [illegible],
AND 5 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
[illegible]	3.1
1 THRU 1[illegible]	[illegible].3
1[illegible]1 THRU 2[illegible]	26.7
2[illegible]1 THRU 3[illegible]	[illegible]
3[illegible]1 THRU 4[illegible]	[illegible]
4[illegible]1 THRU 5[illegible]	[illegible]
5[illegible]1 THRU 6[illegible]	[illegible]
6[illegible]1 THRU 7[illegible]	[illegible]
7[illegible]1 THRU 8[illegible]	[illegible]
8[illegible]1 THRU 9[illegible]	[illegible]
9[illegible]1 THRU1[illegible]	[illegible]
OVER1[illegible]	[illegible]

Figure 26 - TOTAL RAIL CARGO EXPORTED (SIM. I)

NWS CONCORD EXPORT CAPABILITY SIX MONTH 13MAY7

SUMMARY 15
SHIP TIME AT ALL BERTHS (ALL SHIPS)

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 13391 HRS 23 MIN 47 SEC
MAXIMUM TIME 231 HRS 22 MIN 21 SEC (OCCURRED ON DAY [illegible],
BEGINNING AT TIME [illegible])
AVERAGE TIME 194 HRS 4 MIN 42 SEC
MINIMUM TIME 104 HRS 55 MIN 49 SEC (OCCURRED ON DAY 121,
BEGINNING AT TIME 557)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
96	0	0	OR LESS				0	0.0
96	0	0	THRU	108	0	0	1	1.4
108	0	0	THRU	120	0	0	7	10.1
120	0	0	THRU	132	0	0	0	0.0
132	0	0	THRU	144	0	0	0	0.0
144	0	0	THRU	156	0	0	0	0.0
156	0	0	THRU	168	0	0	1	1.4
168	0	0	THRU	180	0	0	2	2.9
180	0	0	THRU	192	0	0	5	7.2
192	0	0	THRU	204	0	0	20	29.0
204	0	0	THRU	216	0	0	19	27.5
216	0	0	THRU	228	0	0	11	15.9
228	0	0	THRU	240	0	0	3	4.3
240	0	0	THRU	252	0	0	0	0.0
252	0	0	THRU	264	0	0	0	0.0
264	0	0	THRU	276	0	0	0	0.0
276	0	0	THRU	288	0	0	0	0.0
		MORE	THAN	288	0	0	0	0.0

TOTAL NUMBER 69

Figure 27 - SHIP TIME AT ALL BERTHS (SIM. I)

NWS CONCORD EXPORT CAPABILITY   SIX MONTH

SHIP DELAY TIMES WAITING FOR BERTHS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME   585 HRS 47 MIN 38 SEC
MAXIMUM TIME 167 HRS 9 MIN 59 SEC (OCCURRED ON DAY [illegible], BEGINNING AT TIME 1249)

AVERAGE TIME 8 HRS 52 MIN 32 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 11. BEGINNING AT TIME 329. AND 57 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	58	87.9
0	0	0	THRU	1	0	0	0	0.0
1	0	0	THRU	2	0	0	0	0.0
2	0	0	THRU	3	0	0	0	0.0
3	0	0	THRU	4	0	0	0	0.0
4	0	0	THRU	5	0	0	0	0.0
5	0	0	THRU	6	0	0	0	0.0
6	0	0	THRU	7	0	0	0	0.0
7	0	0	THRU	8	0	0	0	0.0
8	0	0	THRU	9	0	0	0	0.0
9	0	0	THRU	10	0	0	1	1.5
10	0	0	THRU	11	0	0	0	0.0
11	0	0	THRU	12	0	0	1	1.5
12	0	0	THRU	13	0	0	1	1.5
13	0	0	THRU	14	0	0	0	0.0
14	0	0	THRU	15	0	0	0	0.0
15	0	0	THRU	16	0	0	0	0.0
16	0	0	THRU	17	0	0	0	0.0
17	0	0	THRU	18	0	0	0	0.0
18	0	0	THRU	19	0	0	0	0.0
19	0	0	THRU	20	0	0	0	0.0
		MORE	THAN	20	0	0	5	7.6

TOTAL NUMBER 66

DELAY TIME

TOTAL DELAY   585 HRS 47 MIN 38 SEC
MAXIMUM DELAY 167 HRS 9 MIN 59 SEC (OCCURRED ON DAY [illegible], BEGINNING AT TIME 1249)

AVERAGE DELAY 73 HRS 13 MIN 27 SEC
MINIMUM DELAY 9 HRS 54 MIN 52 SEC (OCCURRED ON DAY 98. BEGINNING AT TIME 1152)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	2	0	0	0	0.0
2	0	0	THRU	4	0	0	0	0.0
4	0	0	THRU	6	0	0	0	0.0
6	0	0	THRU	8	0	0	0	0.0
8	0	0	THRU	10	0	0	1	12.5
10	0	0	THRU	12	0	0	1	12.5
12	0	0	THRU	14	0	0	1	12.5
14	0	0	THRU	16	0	0	0	0.0
16	0	0	THRU	18	0	0	0	0.0
18	0	0	THRU	20	0	0	0	0.0
20	0	0	THRU	22	0	0	0	0.0
22	0	0	THRU	24	0	0	0	0.0
24	0	0	THRU	26	0	0	0	0.0
26	0	0	THRU	28	0	0	0	0.0
28	0	0	THRU	30	0	0	0	0.0
30	0	0	THRU	32	0	0	0	0.0
32	0	0	THRU	34	0	0	0	0.0
34	0	0	THRU	36	0	0	0	0.0
36	0	0	THRU	38	0	0	0	0.0
38	0	0	THRU	40	0	0	0	0.0
40	0	0	THRU	42	0	0	0	0.0
42	0	0	THRU	44	0	0	0	0.0
44	0	0	THRU	46	0	0	0	0.0
46	0	0	THRU	48	0	0	0	0.0
		MORE	THAN	48	0	0	5	62.5

NUMBER DELAYED 8

Figure 28 - SHIP DELAY TIMES (SIM. I)

```
NWS CONCORD EXPORT CAPABILITY                SIX MONTH

SUMMARY 1
        NUMBER OF VANS IN STORAGE AREA


        TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

          TOTAL NUMBER IN REPORT PERIOD     3427
          MAXIMUM    345 (ON DAY     177 AT 1519)
          AVERAGE    177.0[illegible]
          MINIMUM      0 (ON DAY       [illegible] AT [illegible],
                            AND      24 OTHER TIMES)

               NUMBER     PERCENT OF REPORT PERIOD
                  0                    0.8
             1 THRU  25                6.2
            26 THRU  50                5.3
            51 THRU  75                1.3
            76 THRU 100                5.1
           101 THRU 125                3.3
           126 THRU 150                6.7
           151 THRU 175               22.8
           176 THRU 200               13.0
           201 THRU 225                6.8
           226 THRU 250                5.6
           251 THRU 275               10.2
           276 THRU 300                6.7
           301 THRU 325                3.7
           326 THRU 350                2.7
           351 THRU 375                0.0
           376 THRU 400                0.0
           401 THRU 425                0.0
           426 THRU 450                0.0
           451 THRU 475                0.0
           476 THRU 500                0.0
                OVER 500               0.0
```

Figure 29 - NUMBER OF VANS IN STORAGE AREAS (SIM. I)

NWS CONCORD EXPORT CAPABILITY SIX MONTH

SUMMARY 26
STORAGE TIMES OF VANS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 627085 HRS 35 MIN 38 SEC
MAXIMUM TIME 790 HRS 37 MIN 30 SEC (OCCURRED ON DAY 146, BEGINNING AT TIME 1540)
AVERAGE TIME 366 HRS 4 MIN 28 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 0, BEGINNING AT TIME 0 0, AND 9 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	10	0.6
0	0	0	THRU	24	0	0	176	10.3
24	0	0	THRU	48	0	0	89	5.1
48	0	0	THRU	72	0	0	33	1.9
72	0	0	THRU	96	0	0	39	2.3
96	0	0	THRU	120	0	0	11	0.6
120	0	0	THRU	144	0	0	0	0.0
144	0	0	THRU	168	0	0	0	0.0
168	0	0	THRU	192	0	0	26	1.5
192	0	0	THRU	216	0	0	23	1.3
216	0	0	THRU	240	0	0	37	2.2
240	0	0	THRU	264	0	0	28	1.6
264	0	0	THRU	288	0	0	21	1.2
288	0	0	THRU	312	0	0	14	0.8
312	0	0	THRU	336	0	0	43	2.5
336	0	0	THRU	360	0	0	116	6.8
360	0	0	THRU	384	0	0	87	5.1
384	0	0	THRU	408	0	0	198	11.6
408	0	0	THRU	432	0	0	103	6.0
432	0	0	THRU	456	0	0	66	3.9
456	0	0	THRU	480	0	0	81	4.7
480	0	0	THRU	504	0	0	42	2.5
504	0	0	THRU	528	0	0	42	2.5
528	0	0	THRU	552	0	0	56	3.3
552	0	0	THRU	576	0	0	91	5.3
576	0	0	THRU	600	0	0	108	6.3
600	0	0	THRU	624	0	0	42	2.5
624	0	0	THRU	648	0	0	48	2.8
648	0	0	THRU	672	0	0	16	0.9
672	0	0	THRU	696	0	0	5	0.3
696	0	0	THRU	720	0	0	3	0.2
		MORE	THAN	720	0	0	61	3.5

TOTAL NUMBER 1713

DELAY TIME

TOTAL DELAY 627085 HRS 35 MIN 38 SEC
MAXIMUM DELAY 790 HRS 37 MIN 30 SEC (OCCURRED ON DAY 145, BEGINNING AT TIME 1540)
AVERAGE DELAY 368 HRS 13 MIN 27 SEC
MINIMUM DELAY 1 HRS 6 MIN 24 SEC (OCCURRED ON DAY 15, BEGINNING AT TIME 847)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	24	0	0	176	10.3
24	0	0	THRU	48	0	0	88	5.2
48	0	0	THRU	72	0	0	33	1.9
72	0	0	THRU	96	0	0	39	2.3
96	0	0	THRU	120	0	0	11	0.6
120	0	0	THRU	144	0	0	0	0.0
144	0	0	THRU	168	0	0	0	0.0
168	0	0	THRU	192	0	0	26	1.5
192	0	0	THRU	216	0	0	23	1.4
216	0	0	THRU	240	0	0	37	2.2
240	0	0	THRU	264	0	0	28	1.6
264	0	0	THRU	288	0	0	21	1.2
288	0	0	THRU	312	0	0	14	0.8
312	0	0	THRU	336	0	0	43	2.5
336	0	0	THRU	360	0	0	116	6.8
360	0	0	THRU	384	0	0	87	5.1
384	0	0	THRU	408	0	0	198	11.6
408	0	0	THRU	432	0	0	103	6.0
432	0	0	THRU	456	0	0	66	3.9
456	0	0	THRU	480	0	0	81	4.8
480	0	0	THRU	504	0	0	42	2.5
504	0	0	THRU	528	0	0	42	2.5
528	0	0	THRU	552	0	0	56	3.3
552	0	0	THRU	576	0	0	91	5.3
576	0	0	THRU	600	0	0	108	6.3
600	0	0	THRU	624	0	0	42	2.5
624	0	0	THRU	648	0	0	48	2.8
648	0	0	THRU	672	0	0	16	0.9
672	0	0	THRU	696	0	0	5	0.3
696	0	0	THRU	720	0	0	3	0.2
		MORE	THAN	720	0	0	61	3.5

NUMBER DELAYED 1703

Figure 30 - STORAGE TIMES OF VANS (SIM. I)

NWS CONCORD EXPORT CAPABILITY   SIX MONTH   13MAY77

SUMMARY 2
NUMBER OF TRAINS (1[illegible] CARS PER TRAIN) AT STORAGE AREA

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 1127
MAXIMUM 142 (ON DAY 179 AT [illegible])
AVERAGE 72.2[illegible]
MINIMUM [illegible] (ON DAY [illegible] AT [illegible],
AND 1 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
[illegible]	[illegible]
1 THRU 5	[illegible]
6 THRU 10	[illegible].0
11 THRU 15	[illegible].4
16 THRU 20	5.4
21 THRU 25	3.[illegible]
26 THRU 30	2.8
31 THRU 35	1.3
36 THRU 40	2.9
41 THRU 45	4.[illegible]
46 THRU 50	1.5
51 THRU 55	5.2
56 THRU 60	5.1
61 THRU 65	3.4
66 THRU 70	4.9
71 THRU 75	11.[illegible]
76 THRU 80	8.3
81 THRU 85	8.[illegible]
86 THRU 90	6.7
91 THRU 95	5.2
96 THRU 100	6.3
OVER 100	14.2

Figure 31 - NUMBER OF TRAINS AT STORAGE AREA (SIM. I)

NWS CONCORD EXPORT CAPABILITY   SIX MONTH

SUMMARY 27
STORAGE TIMES OF RAILCARS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 255753 HRS 16 MIN 53 SEC
MAXIMUM TIME 868 HRS 51 MIN 8 SEC (OCCURRED ON DAY 143, BEGINNING AT TIME 8.0)
AVERAGE TIME 454 HRS 16 MIN 7 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 0, BEGINNING AT TIME 0.0, AND 5 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	6	1.1
0	0	0	THRU	24	0	0	5	0.9
24	0	0	THRU	48	0	0	5	0.9
48	0	0	THRU	72	0	0	8	1.4
72	0	0	THRU	96	0	0	18	3.2
96	0	0	THRU	120	0	0	30	5.3
120	0	0	THRU	144	0	0	20	3.6
144	0	0	THRU	168	0	0	11	2.0
168	0	0	THRU	192	0	0	14	2.5
192	0	0	THRU	216	0	0	2	0.4
216	0	0	THRU	240	0	0	2	0.4
240	0	0	THRU	264	0	0	3	0.5
264	0	0	THRU	288	0	0	1	0.2
288	0	0	THRU	312	0	0	4	0.7
312	0	0	THRU	336	0	0	10	1.8
336	0	0	THRU	360	0	0	1	0.2
360	0	0	THRU	384	0	0	8	1.4
384	0	0	THRU	408	0	0	17	3.0
408	0	0	THRU	432	0	0	17	3.0
432	0	0	THRU	456	0	0	38	6.7
456	0	0	THRU	480	0	0	49	8.7
480	0	0	THRU	504	0	0	57	10.1
504	0	0	THRU	528	0	0	34	6.0
528	0	0	THRU	552	0	0	34	6.0
552	0	0	THRU	576	0	0	25	4.4
576	0	0	THRU	600	0	0	17	3.0
600	0	0	THRU	624	0	0	9	1.6
624	0	0	THRU	648	0	0	10	1.8
648	0	0	THRU	672	0	0	6	1.1
672	0	0	THRU	696	0	0	17	3.0
696	0	0	THRU	720	0	0	19	3.4
		MORE	THAN	720	0	0	66	11.7

TOTAL NUMBER 563

DELAY TIME

TOTAL DELAY 255753 HRS 16 MIN 53 SEC
MAXIMUM DELAY 868 HRS 51 MIN 8 SEC (OCCURRED ON DAY 143, BEGINNING AT TIME 8.0)
AVERAGE DELAY 459 HRS 9 MIN 43 SEC
MINIMUM DELAY 19 HRS 47 MIN 27 SEC (OCCURRED ON DAY 0, BEGINNING AT TIME 0.0)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	24	0	0	5	0.9
24	0	0	THRU	48	0	0	5	0.9
48	0	0	THRU	72	0	0	8	1.4
72	0	0	THRU	96	0	0	18	3.2
96	0	0	THRU	120	0	0	30	5.4
120	0	0	THRU	144	0	0	20	3.6
144	0	0	THRU	168	0	0	11	2.0
168	0	0	THRU	192	0	0	14	2.5
192	0	0	THRU	216	0	0	2	0.4
216	0	0	THRU	240	0	0	2	0.4
240	0	0	THRU	264	0	0	3	0.5
264	0	0	THRU	288	0	0	1	0.2
288	0	0	THRU	312	0	0	4	0.7
312	0	0	THRU	336	0	0	10	1.8
336	0	0	THRU	360	0	0	1	0.2
360	0	0	THRU	384	0	0	8	1.4
384	0	0	THRU	408	0	0	17	3.1
408	0	0	THRU	432	0	0	17	3.1
432	0	0	THRU	456	0	0	38	6.8
456	0	0	THRU	480	0	0	49	8.8
480	0	0	THRU	504	0	0	57	10.2
504	0	0	THRU	528	0	0	34	6.1
528	0	0	THRU	552	0	0	34	6.1
552	0	0	THRU	576	0	0	25	4.5
576	0	0	THRU	600	0	0	17	3.1
600	0	0	THRU	624	0	0	9	1.6
624	0	0	THRU	648	0	0	10	1.8
648	0	0	THRU	672	0	0	6	1.1
672	0	0	THRU	696	0	0	17	3.1
696	0	0	THRU	720	0	0	19	3.4
		MORE	THAN	720	0	0	66	11.8

NUMBER DELAYED 557

Figure 32 - STORAGE TIMES OF RAILCARS (SIM. I)

APPENDIX F

RESULTS OF SIMULATION RUN II

Simulation run II was a run attempting to achieve 62.5 percent berth occupancy. The vessel arrivals were Poisson distributed with a mean interarrival time of 57 hours in order to generate about 76 vessels in the 180 day period.

Train arrivals remained the same as for simulation run I with no trains arriving 25 percent of the days, one train arriving 50 percent of the days and two trains arriving 25 percent of the days. Arriving trains had 30 cars 50 percent of the time and 40 cars the remainder of the time. Therefore, on the average, 35 railcars arrived each day.

Truck arrivals were Poisson distributed with a mean interarrival time of 45 minutes during normal operations. When the number of vans in the storage area was less than 10, the mean interarrival time was 15 minutes and when the number of vans in the storage area was greater than 150, the mean interarrival time was 75 minutes. This was the first of the five simulation runs to use the non-homogeneous arrival distribution. The average number of truck arrivals per eight hour receiving period was expected to be 10.6.

The results of simulation run II are shown in the accompanying figures and are summarized as follows:

1) Occupancy rate was 3.62/6 = 60.3 percent.
2) Van cargo exported was (1929)(18) = 34722 long tons.
3) Rail cargo exported was (597)(540) = 322,380 long

tons.

4) Total cargo exported was 322380 + 34722 = 357,102 long tons.

5) Number of vessels turned around was 77.

6) Percent of vessels delayed was 100 - 64.9 = 35.1 percent.

7) Average/maximum number of vans in the storage area was 98.0/226.

8) Average van storage time was about 204.5 hours.

9) Average/maximum number of railcars in the storage area was 114.3/500.

10) Average railcar storage time was about 78.5 hours.

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 17MAY77

SUMMARY 10

OCCUPANCY OF ALL BERTHS (TOTAL NUMBER OF SHIPS IN PORT)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

```
TOTAL NUMBER IN REPORT PERIOD        77
MAXIMUM        6 (ON DAY      0 AT   8 0,
                 AND      36 OTHER TIMES)
AVERAGE        3.62
MINIMUM        0 (ON DAY      0 AT   0 0,
                 AND       2 OTHER TIMES)
```

NUMBER		PERCENT OF REPORT PERIOD
0		0.9
1 THRU	1	10.1
2 THRU	2	22.7
3 THRU	3	22.0
4 THRU	4	9.3
5 THRU	5	7.0
6 THRU	6	28.0
OVER	6	0.0

Figure 33 - OCCUPANCY OF ALL BERTHS (SIM. II)

NWS CONCORD EXPORT CAPABILITY   SIX MONTHS   17MAY77

SUMMARY 12

TOTAL TRUCK CARGO EXPORTED (UNITS OF 18 LONGTON)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD   1929
MAXIMUM   204 (ON DAY   92 AT   330)
AVERAGE   83.44
MINIMUM   0 (ON DAY   0 AT   0 0,
AND   2 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
0	1.0
1 THRU 100	66.1
101 THRU 200	31.6
201 THRU 300	1.3
301 THRU 400	0.0
401 THRU 500	0.0
501 THRU 600	0.0
601 THRU 700	0.0
701 THRU 800	0.0
801 THRU 900	0.0
901 THRU1000	0.0
OVER1000	0.0

Figure 34 - TOTAL TRUCK CARGO EXPORTED (SIM. II)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 17MAY77

SUMMARY 13

TOTAL RAIL CARGO EXPORTED (UNITS OF 540 LONGTONS)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 597
MAXIMUM 50 (ON DAY 178 AT 123)
AVERAGE 16.99
MINIMUM 0 (ON DAY 0 AT 0 0)

NUMBER	PERCENT OF REPORT PERIOD
0	0.6
1 THRU 100	99.4
101 THRU 200	0.0
201 THRU 300	0.0
301 THRU 400	0.0
401 THRU 500	0.0
501 THRU 600	0.0
601 THRU 700	0.0
701 THRU 800	0.0
801 THRU 900	0.0
901 THRU1000	0.0
OVER1000	0.0

Figure 35 - TOTAL RAIL CARGO EXPORTED (SIM. II)

NWS CONCORD EXPORT CAPABILITY   SIX MONTHS   17MAY7

SUMMARY 15
SHIP TIME AT ALL BERTHS (ALL SHIPS)

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME	15195	HRS	26	MIN	22	SEC						
MAXIMUM TIME	233	HRS	22	MIN	10	SEC	(OCCURRED ON DAY 1[illegible]8, BEGINNING AT TIME 1342)					
AVERAGE TIME	197	HRS	20	MIN	36	SEC						
MINIMUM TIME	105	HRS	8	MIN	59	SEC	(OCCURRED ON DAY 142, BEGINNING AT TIME 2341)					

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
96	0	0	OR LESS				0	0.0
96	0	0	THRU	108	0	0	1	1.3
108	0	0	THRU	120	0	0	6	7.8
120	0	0	THRU	132	0	0	1	1.3
132	0	0	THRU	144	0	0	0	0.0
144	0	0	THRU	156	0	0	0	0.0
156	0	0	THRU	168	0	0	0	0.0
168	0	0	THRU	180	0	0	2	2.6
180	0	0	THRU	192	0	0	4	5.2
192	0	0	THRU	204	0	0	22	28.6
204	0	0	THRU	216	0	0	26	33.8
216	0	0	THRU	228	0	0	13	16.9
228	0	0	THRU	240	0	0	2	2.6
240	0	0	THRU	252	0	0	0	0.0
252	0	0	THRU	264	0	0	0	0.0
264	0	0	THRU	276	0	0	0	0.0
276	0	0	THRU	288	0	0	0	0.0
			MORE THAN	288	0	0	0	0.0
			TOTAL NUMBER				77	

Figure 36 - SHIP TIME AT ALL BERTHS (SIM. II)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS

SUMMARY 14
SHIP DELAY TIMES WAITING FOR BERTHS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 2120 HRS 43 MIN 47 SEC
MAXIMUM TIME 164 HRS 6 MIN 30 SEC (OCCURRED ON DAY 2, BEGINNING AT TIME 1225)

AVERAGE TIME 27 HRS 32 MIN 31 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 22, BEGINNING AT TIME 1526, AND 49 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	50	64.9
0	0	0	THRU	1	0	0	0	0.0
1	0	0	THRU	2	0	0	0	0.0
2	0	0	THRU	3	0	0	1	1.3
3	0	0	THRU	4	0	0	0	0.0
4	0	0	THRU	5	0	0	0	0.0
5	0	0	THRU	6	0	0	1	1.3
6	0	0	THRU	7	0	0	0	0.0
7	0	0	THRU	8	0	0	0	0.0
8	0	0	THRU	9	0	0	1	1.3
9	0	0	THRU	10	0	0	0	0.0
10	0	0	THRU	11	0	0	1	1.3
11	0	0	THRU	12	0	0	1	1.3
12	0	0	THRU	13	0	0	0	0.0
13	0	0	THRU	14	0	0	0	0.0
14	0	0	THRU	15	0	0	1	1.3
15	0	0	THRU	16	0	0	0	0.0
16	0	0	THRU	17	0	0	0	0.0
17	0	0	THRU	18	0	0	0	0.0
18	0	0	THRU	19	0	0	0	0.0
19	0	0	THRU	20	0	0	0	0.0
		MORE	THAN	20	0	0	21	27.3

TOTAL NUMBER 77

DELAY TIME

TOTAL DELAY 2120 HRS 43 MIN 47 SEC
MAXIMUM DELAY 164 HRS 6 MIN 30 SEC (OCCURRED ON DAY 2, BEGINNING AT TIME 1225)

AVERAGE DELAY 78 HRS 32 MIN 44 SEC
MINIMUM DELAY 2 HRS 39 MIN 58 SEC (OCCURRED ON DAY 26, BEGINNING AT TIME 3 4)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	2	0	0	0	0.0
2	0	0	THRU	4	0	0	1	3.7
4	0	0	THRU	6	0	0	1	3.7
6	0	0	THRU	8	0	0	0	0.0
8	0	0	THRU	10	0	0	1	3.7
10	0	0	THRU	12	0	0	2	7.4
12	0	0	THRU	14	0	0	0	0.0
14	0	0	THRU	16	0	0	1	3.7
16	0	0	THRU	18	0	0	0	0.0
18	0	0	THRU	20	0	0	0	0.0
20	0	0	THRU	22	0	0	0	0.0
22	0	0	THRU	24	0	0	0	0.0
24	0	0	THRU	26	0	0	1	3.7
26	0	0	THRU	28	0	0	0	0.0
28	0	0	THRU	30	0	0	0	0.0
30	0	0	THRU	32	0	0	0	0.0
32	0	0	THRU	34	0	0	0	0.0
34	0	0	THRU	36	0	0	0	0.0
36	0	0	THRU	38	0	0	0	0.0
38	0	0	THRU	40	0	0	0	0.0
40	0	0	THRU	42	0	0	0	0.0
42	0	0	THRU	44	0	0	1	3.7
44	0	0	THRU	46	0	0	0	0.0
46	0	0	THRU	48	0	0	0	0.0
		MORE	THAN	48	0	0	19	70.4

NUMBER DELAYED 27

Figure 37 - SHIP DELAY TIMES (SIM. II)

SUMMARY 1

NUMBER OF VANS IN STORAGE AREA

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 4071
MAXIMUM 226 (ON DAY 168 AT 1522)
AVERAGE 98.01
MINIMUM 0 (ON DAY 0 AT 8.0,
AND 52 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
0	0.9
1 THRU 25	19.4
26 THRU 50	8.6
51 THRU 75	9.0
76 THRU 100	11.0
101 THRU 125	10.2
126 THRU 150	15.1
151 THRU 175	19.3
176 THRU 200	3.7
201 THRU 225	2.6
226 THRU 250	0.1
251 THRU 275	0.0
276 THRU 300	0.0
301 THRU 325	0.0
326 THRU 350	0.0
351 THRU 375	0.0
376 THRU 400	0.0
OVER 400	0.0

Figure 38 - NUMBER OF VANS IN STORAGE AREAS (SIM. II)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS

SUMMARY 26
STORAGE TIMES OF VANS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 415993 HRS 24 MIN 23 SEC
MAXIMUM TIME 775 HRS 18 MIN 54 SEC (OCCURRED ON DAY 136, BEGINNING AT TIME 1520)

AVERAGE TIME 204 HRS 25 MIN 10 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 0, BEGINNING AT TIME 8 0, AND 14 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	15	0.7
0	0	0	THRU	24	0	0	417	22.5
24	0	0	THRU	48	0	0	223	11.0
48	0	0	THRU	72	0	0	144	7.1
72	0	0	THRU	96	0	0	32	1.6
96	0	0	THRU	120	0	0	92	4.5
120	0	0	THRU	144	0	0	38	1.9
144	0	0	THRU	168	0	0	30	1.5
168	0	0	THRU	192	0	0	80	3.9
192	0	0	THRU	216	0	0	89	4.4
216	0	0	THRU	240	0	0	92	4.5
240	0	0	THRU	264	0	0	60	2.9
264	0	0	THRU	288	0	0	78	3.8
288	0	0	THRU	312	0	0	38	1.9
312	0	0	THRU	336	0	0	50	2.5
336	0	0	THRU	360	0	0	125	6.1
360	0	0	THRU	384	0	0	78	3.8
384	0	0	THRU	408	0	0	71	3.5
408	0	0	THRU	432	0	0	52	2.6
432	0	0	THRU	456	0	0	27	1.3
456	0	0	THRU	480	0	0	25	1.2
480	0	0	THRU	504	0	0	38	1.9
504	0	0	THRU	528	0	0	19	0.9
528	0	0	THRU	552	0	0	7	0.3
552	0	0	THRU	576	0	0	6	0.3
576	0	0	THRU	600	0	0	15	0.8
600	0	0	THRU	624	0	0	24	1.2
624	0	0	THRU	648	0	0	4	0.2
648	0	0	THRU	672	0	0	9	0.4
672	0	0	THRU	696	0	0	7	0.3
696	0	0	THRU	720	0	0	18	0.9
		MORE	THAN	720	0	0	31	1.5

TOTAL NUMBER 2035

DELAY TIME

TOTAL DELAY 415993 HRS 24 MIN 23 SEC
MAXIMUM DELAY 775 HRS 18 MIN 54 SEC (OCCURRED ON DAY 136, BEGINNING AT TIME 1520)

AVERAGE DELAY 205 HRS 56 MIN 14 SEC
MINIMUM DELAY 0 HRS 18 MIN 46 SEC (OCCURRED ON DAY 27, BEGINNING AT TIME 813)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	24	0	0	417	20.6
24	0	0	THRU	48	0	0	223	11.0
48	0	0	THRU	72	0	0	144	7.1
72	0	0	THRU	96	0	0	32	1.6
96	0	0	THRU	120	0	0	92	4.6
120	0	0	THRU	144	0	0	38	1.9
144	0	0	THRU	168	0	0	30	1.5
168	0	0	THRU	192	0	0	80	4.0
192	0	0	THRU	216	0	0	89	4.4
216	0	0	THRU	240	0	0	92	4.6
240	0	0	THRU	264	0	0	60	3.0
264	0	0	THRU	288	0	0	78	3.9
288	0	0	THRU	312	0	0	38	1.9
312	0	0	THRU	336	0	0	50	2.5
336	0	0	THRU	360	0	0	125	6.2
360	0	0	THRU	384	0	0	78	3.9
384	0	0	THRU	408	0	0	71	3.5
408	0	0	THRU	432	0	0	52	2.6
432	0	0	THRU	456	0	0	27	1.3
456	0	0	THRU	480	0	0	25	1.2
480	0	0	THRU	504	0	0	38	1.9
504	0	0	THRU	528	0	0	19	0.9
528	0	0	THRU	552	0	0	7	0.3
552	0	0	THRU	576	0	0	6	0.3
576	0	0	THRU	600	0	0	16	0.8
600	0	0	THRU	624	0	0	24	1.2
624	0	0	THRU	648	0	0	4	0.2
648	0	0	THRU	672	0	0	9	0.4
672	0	0	THRU	696	0	0	7	0.3
696	0	0	THRU	720	0	0	19	0.9
		MORE	THAN	720	0	0	31	1.5

NUMBER DELAYED 2020

Figure 39 - STORAGE TIMES OF VANS (SIM. II)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 17MAY77

SUMMARY 2
NUMBER OF TRAINS (10 CARS PER TRAIN) AT STORAGE AREA

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 1251
MAXIMUM 51 (ON DAY 0 AT 8 0)

AVERAGE 11.43
MINIMUM 0 (ON DAY 0 AT 8 0,
AND 136 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
0	24.7
1 THRU 5	20.9
6 THRU 10	14.0
11 THRU 15	8.4
16 THRU 20	7.4
21 THRU 25	8.9
26 THRU 30	8.3
31 THRU 35	2.4
36 THRU 40	2.1
41 THRU 45	1.9
46 THRU 50	1.0
51 THRU 55	0.0
56 THRU 60	0.0
61 THRU 65	0.0
66 THRU 70	0.0
71 THRU 75	0.0
76 THRU 80	0.0
81 THRU 85	0.0
86 THRU 90	0.0
91 THRU 95	0.0
96 THRU 100	0.0
OVER 100	0.0

Figure 40 - NUMBER OF TRAINS AT STORAGE AREA (SIM. II)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS

SUMMARY 27
STORAGE TIMES OF RAILCARS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 49051 HRS 28 MIN 57 SEC
MAXIMUM TIME 281 HRS 30 MIN 4 SEC (OCCURRED ON DAY 160. BEGINNING AT TIME 8 0)
AVERAGE TIME 78 HRS 28 MIN 57 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 0. BEGINNING AT TIME 8 0. AND 127 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	128	20.5
0	0	0	THRU	24	0	0	76	12.2
24	0	0	THRU	48	0	0	62	9.9
48	0	0	THRU	72	0	0	80	12.8
72	0	0	THRU	96	0	0	55	8.8
96	0	0	THRU	120	0	0	45	7.2
120	0	0	THRU	144	0	0	33	5.3
144	0	0	THRU	168	0	0	53	8.5
168	0	0	THRU	192	0	0	54	8.6
192	0	0	THRU	216	0	0	15	2.4
216	0	0	THRU	240	0	0	10	1.6
240	0	0	THRU	264	0	0	7	1.1
264	0	0	THRU	288	0	0	7	1.1
288	0	0	THRU	312	0	0	0	0.0
312	0	0	THRU	336	0	0	0	0.0
336	0	0	THRU	360	0	0	0	0.0
360	0	0	THRU	384	0	0	0	0.0
384	0	0	THRU	408	0	0	0	0.0
408	0	0	THRU	432	0	0	0	0.0
432	0	0	THRU	456	0	0	0	0.0
456	0	0	THRU	480	0	0	0	0.0
480	0	0	THRU	504	0	0	0	0.0
504	0	0	THRU	528	0	0	0	0.0
528	0	0	THRU	552	0	0	0	0.0
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	0	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	0	0	THRU	696	0	0	0	0.0
696	0	0	THRU	720	0	0	0	0.0
	MORE		THAN	720	0	0	0	0.0

TOTAL NUMBER 625

DELAY TIME

TOTAL DELAY 49051 HRS 28 MIN 57 SEC
MAXIMUM DELAY 281 HRS 30 MIN 4 SEC (OCCURRED ON DAY 150. BEGINNING AT TIME 8 0)
AVERAGE DELAY 98 HRS 41 MIN 42 SEC
MINIMUM DELAY 0 HRS 10 MIN 38 SEC (OCCURRED ON DAY 95. BEGINNING AT TIME 8 0)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	24	0	0	76	15.3
24	0	0	THRU	48	0	0	62	12.5
48	0	0	THRU	72	0	0	80	16.1
72	0	0	THRU	96	0	0	55	11.1
96	0	0	THRU	120	0	0	45	9.1
120	0	0	THRU	144	0	0	33	6.6
144	0	0	THRU	168	0	0	53	10.7
168	0	0	THRU	192	0	0	54	10.9
192	0	0	THRU	216	0	0	15	3.0
216	0	0	THRU	240	0	0	10	2.0
240	0	0	THRU	264	0	0	7	1.4
264	0	0	THRU	288	0	0	7	1.4
288	0	0	THRU	312	0	0	0	0.0
312	0	0	THRU	336	0	0	0	0.0
336	0	0	THRU	360	0	0	0	0.0
360	0	0	THRU	384	0	0	0	0.0
384	0	0	THRU	408	0	0	0	0.0
408	0	0	THRU	432	0	0	0	0.0
432	0	0	THRU	456	0	0	0	0.0
456	0	0	THRU	480	0	0	0	0.0
480	0	0	THRU	504	0	0	0	0.0
504	0	0	THRU	528	0	0	0	0.0
528	0	0	THRU	552	0	0	0	0.0
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	0	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	0	0	THRU	696	0	0	0	0.0
696	0	0	THRU	720	0	0	0	0.0
	MORE		THAN	720	0	0	0	0.0

NUMBER DELAYED 497

Figure 41 - STORAGE TIMES OF RAILCARS (SIM. II)

APPENDIX G

RESULTS OF SIMULATION RUN III

Simulation run III was run attempting to achieve 62.5 percent berth occupancy. The vessel arrivals were Poisson distributed with a mean interarrival of 57 hours in order to generate about 76 vessels in the 180 day period. This run was given a new seed to increase the randomness of the results.

Train arrivals were given a distribution of no trains arriving 25 percent of the days, one train 50 percent of the days, and two trains arriving 25 percent of the days. Arriving trains had 30 cars 50 percent of the time and 40 cars the remainder of the time. Therefore, on the average, 35 railcars arrived each day.

Truck arrivals were Poisson distributed with a mean interarrival time of 45 minutes during normal operations. When the number of vans in the storage area was less than 10, the mean interarrival time was 15 minutes and when the number of vans in the storage area was greater than 150, the mean interarrival time was 75 minutes. The average number of truck arrivals per eight hour receiving period was expected to be 10.6.

The results for simulation run III are shown in the accompanying figures and are summarized as follows:

1) Occupancy rate was 4.16/6 = 69.3 percent.

2) Van cargo exported was (2253)(18) = 40554 long tons.

3) Rail cargo exported was (659)(540) = 356860 long tons.

4) Total cargo exported was 356860 + 40554 = 397,414 long tons.

5) Number of vessels turned around was 90.

6) Percent of vessels delayed was 100 - 66.3 = 33.7 percent.

7) Average/maximum number of vans in the storage area was 54.9/185.

8) Average van storage time was about 96.0 hours.

9) Average/maximum number of railcars in the storage area was 136/650.

10) Average railcar storage time was about 75.0 hours.

```
NWS CONCORD EXPORT CAPABILITY                    SIX MONTHS    18MAY7
SUMMARY 13
        OCCUPANCY OF ALL BERTHS (TOTAL NUMBER OF SHIPS IN PORT)


            TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

              TOTAL NUMBER IN REPORT PERIOD       90
              MAXIMUM       6 (ON DAY        0 AT   8 0,
                               AND       41 OTHER TIMES)
              AVERAGE       4.16
              MINIMUM       0 (ON DAY        0 AT   0 0,
                               AND        2 OTHER TIMES)

                 NUMBER      PERCENT OF REPORT PERIOD
                   0                    1.6
                 1 THRU     1           5.8
                 2 THRU     2          11.6
                 3 THRU     3          15.1
                 4 THRU     4          20.1
                 5 THRU     5          13.2
                 6 THRU     6          32.6
                   OVER     6           0.0
```

Figure 42 - OCCUPANCY OF ALL BERTHS (SIM. III)

NWS CONCORD EXPORT CAPABILITY   SIX MONTHS   18M/

SUMMARY 12
TOTAL TRUCK CARGO EXPORTED (UNITS OF 18 LONGTON)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD   2253
MAXIMUM   225 (ON DAY   13 AT 2042)
AVERAGE   94.81
MINIMUM   0 (ON DAY   0 AT 0 0,
AND   2 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
0	1.7
1 THRU 100	51.8
101 THRU 200	44.5
201 THRU 300	2.0
301 THRU 400	0.0
401 THRU 500	0.0
501 THRU 600	0.0
601 THRU 700	0.0
701 THRU 800	0.0
801 THRU 900	0.0
901 THRU1000	0.0
OVER1000	0.0

Figure 43 - TOTAL TRUCK CARGO EXPORTED (SIM. III)

NWS CONCORD EXPORT CAPABILITY   SIX MONTHS   18MAY77

SUMMARY 13

TOTAL RAIL CARGO EXPORTED (UNITS OF 540 LONGTONS)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 659
MAXIMUM 46 (ON DAY 16 AT 1730)
AVERAGE 17.05
MINIMUM 0 (ON DAY 0 AT 0 0)

NUMBER	PERCENT OF REPORT PERIOD
0	0.6
1 THRU 100	99.4
101 THRU 200	0.0
201 THRU 300	0.0
301 THRU 400	0.0
401 THRU 500	0.0
501 THRU 600	0.0
601 THRU 700	0.0
701 THRU 800	0.0
801 THRU 900	0.0
901 THRU1000	0.0
OVER1000	0.0

Figure 44 - TOTAL RAIL CARGO EXPORTED (SIM. III)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 18MAY7

SUMMARY 15
SHIP TIME AT ALL BERTHS (ALL SHIPS)

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 17865 HRS 27 MIN 25 SEC
MAXIMUM TIME 238 HRS 15 MIN 59 SEC (OCCURRED ON DAY 51, BEGINNING AT TIME 1035)

AVERAGE TIME 198 HRS 30 MIN 18 SEC
MINIMUM TIME 108 HRS 31 MIN 7 SEC (OCCURRED ON DAY 124, BEGINNING AT TIME 1024)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
96	0	0	OR LESS				0	0.0
96	0	0	THRU	108	0	0	0	0.0
108	0	0	THRU	120	0	0	5	5.6
120	0	0	THRU	132	0	0	1	1.1
132	0	0	THRU	144	0	0	0	0.0
144	0	0	THRU	156	0	0	0	0.0
156	0	0	THRU	168	0	0	4	4.4
168	0	0	THRU	180	0	0	0	0.0
180	0	0	THRU	192	0	0	5	5.6
192	0	0	THRU	204	0	0	32	35.6
204	0	0	THRU	216	0	0	24	26.7
216	0	0	THRU	228	0	0	18	20.0
228	0	0	THRU	240	0	0	1	1.1
240	0	0	THRU	252	0	0	0	0.0
252	0	0	THRU	264	0	0	0	0.0
264	0	0	THRU	276	0	0	0	0.0
276	0	0	THRU	288	0	0	0	0.0
		MORE	THAN	288	0	0	0	0.0
			TOTAL NUMBER				90	

Figure 45 - SHIP TIME AT ALL BERTHS (SIM. III)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS

SHIP DELAY TIMES WAITING FOR BERTHS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 1838 HRS 51 MIN 52 SEC
MAXIMUM TIME 187 HRS 38 MIN 11 SEC (OCCURRED ON DAY 0. BEGINNING AT TIME 1239)
AVERAGE TIME 21 HRS 22 MIN 56 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 28. BEGINNING AT TIME 1253. AND 56 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	57	66.3
0	0	0	THRU	1	0	0	0	0.0
1	0	0	THRU	2	0	0	0	0.0
2	0	0	THRU	3	0	0	0	0.0
3	0	0	THRU	4	0	0	1	1.2
4	0	0	THRU	5	0	0	1	1.2
5	0	0	THRU	6	0	0	0	0.0
6	0	0	THRU	7	0	0	0	0.0
7	0	0	THRU	8	0	0	0	0.0
8	0	0	THRU	9	0	0	0	0.0
9	0	0	THRU	10	0	0	0	0.0
10	0	0	THRU	11	0	0	0	0.0
11	0	0	THRU	12	0	0	1	1.2
12	0	0	THRU	13	0	0	0	0.0
13	0	0	THRU	14	0	0	1	1.2
14	0	0	THRU	15	0	0	0	0.0
15	0	0	THRU	16	0	0	1	1.2
16	0	0	THRU	17	0	0	0	0.0
17	0	0	THRU	18	0	0	1	1.2
18	0	0	THRU	19	0	0	0	0.0
19	0	0	THRU	20	0	0	2	2.3
	MORE		THAN	20	0	0	21	24.4

TOTAL NUMBER 86

DELAY TIME

TOTAL DELAY 1838 HRS 51 MIN 52 SEC
MAXIMUM DELAY 187 HRS 38 MIN 11 SEC (OCCURRED ON DAY 0. BEGINNING AT TIME 1239)
AVERAGE DELAY 63 HRS 24 MIN 33 SEC
MINIMUM DELAY 3 HRS 9 MIN 2 SEC (OCCURRED ON DAY 17. BEGINNING AT TIME 1944)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	2	0	0	0	0.0
2	0	0	THRU	4	0	0	1	3.4
4	0	0	THRU	6	0	0	1	3.4
6	0	0	THRU	8	0	0	0	0.0
8	0	0	THRU	10	0	0	0	0.0
10	0	0	THRU	12	0	0	1	3.4
12	0	0	THRU	14	0	0	1	3.4
14	0	0	THRU	16	0	0	1	3.4
16	0	0	THRU	18	0	0	1	3.4
18	0	0	THRU	20	0	0	2	6.9
20	0	0	THRU	22	0	0	1	3.4
22	0	0	THRU	24	0	0	1	3.4
24	0	0	THRU	26	0	0	0	0.0
26	0	0	THRU	28	0	0	3	10.3
28	0	0	THRU	30	0	0	0	0.0
30	0	0	THRU	32	0	0	1	3.4
32	0	0	THRU	34	0	0	0	0.0
34	0	0	THRU	36	0	0	0	0.0
36	0	0	THRU	38	0	0	1	3.4
38	0	0	THRU	40	0	0	1	3.4
40	0	0	THRU	42	0	0	0	0.0
42	0	0	THRU	44	0	0	0	0.0
44	0	0	THRU	46	0	0	0	0.0
46	0	0	THRU	48	0	0	0	0.0
	MORE		THAN	48	0	0	13	44.8

NUMBER DELAYED 29

Figure 46 - SHIP DELAY TIMES (SIM. III)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 18MAY7

SUMMARY 1

NUMBER OF VANS IN STORAGE AREA

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 4627
MAXIMUM 185 (ON DAY 158 AT 1522)
AVERAGE 54.94
MINIMUM 0 (ON DAY 0 AT 8 0,
AND 172 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
0	3.8
1 THRU 25	32.7
26 THRU 50	20.6
51 THRU 75	17.8
76 THRU 100	6.8
101 THRU 125	6.1
126 THRU 150	5.9
151 THRU 175	5.4
176 THRU 200	0.9
201 THRU 225	0.0
226 THRU 250	0.0
251 THRU 275	0.0
276 THRU 300	0.0
301 THRU 325	0.0
326 THRU 350	0.0
351 THRU 375	0.0
376 THRU 400	0.0
OVER 400	0.0

Figure 47 - NUMBER OF VANS IN STORAGE AREAS (SIM. III)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS

SUMMARY 26
STORAGE TIMES OF VANS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 222151 HRS 53 MIN 8 SEC
MAXIMUM TIME 506 HRS 33 MIN 21 SEC (OCCURRED ON DAY 148. BEGINNING AT TIME 1046)
AVERAGE TIME 96 HRS 2 MIN 42 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 0. BEGINNING AT TIME 0.0. AND 54 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	55	2.4
0	0	0	THRU	24	0	0	710	30.7
24	0	0	THRU	48	0	0	359	15.5
48	0	0	THRU	72	0	0	253	10.9
72	0	0	THRU	96	0	0	200	8.6
96	0	0	THRU	120	0	0	169	7.3
120	0	0	THRU	144	0	0	82	3.5
144	0	0	THRU	168	0	0	61	2.6
168	0	0	THRU	192	0	0	60	2.6
192	0	0	THRU	216	0	0	44	1.9
216	0	0	THRU	240	0	0	31	1.3
240	0	0	THRU	264	0	0	42	1.8
264	0	0	THRU	288	0	0	27	1.2
288	0	0	THRU	312	0	0	18	0.8
312	0	0	THRU	336	0	0	23	1.0
336	0	0	THRU	360	0	0	14	0.6
360	0	0	THRU	384	0	0	19	0.8
384	0	0	THRU	408	0	0	49	2.1
408	0	0	THRU	432	0	0	30	1.3
432	0	0	THRU	456	0	0	29	1.3
456	0	0	THRU	480	0	0	15	0.6
480	0	0	THRU	504	0	0	13	0.6
504	0	0	THRU	528	0	0	10	0.4
528	0	0	THRU	552	0	0	0	0.0
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	0	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	0	0	THRU	696	0	0	0	0.0
696	0	0	THRU	720	0	0	0	0.0
		MORE	THAN	720	0	0	0	0.0

TOTAL NUMBER 2313

DELAY TIME

TOTAL DELAY 222151 HRS 58 MIN 8 SEC
MAXIMUM DELAY 506 HRS 33 MIN 21 SEC (OCCURRED ON DAY 148. BEGINNING AT TIME 1046)
AVERAGE DELAY 98 HRS 23 MIN 4 SEC
MINIMUM DELAY 0 HRS 6 MIN 59 SEC (OCCURRED ON DAY 118. BEGINNING AT TIME 913)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	24	0	0	710	31.4
24	0	0	THRU	48	0	0	359	15.9
48	0	0	THRU	72	0	0	253	11.2
72	0	0	THRU	96	0	0	200	8.9
96	0	0	THRU	120	0	0	169	7.5
120	0	0	THRU	144	0	0	82	3.6
144	0	0	THRU	168	0	0	61	2.7
168	0	0	THRU	192	0	0	60	2.7
192	0	0	THRU	216	0	0	44	1.9
216	0	0	THRU	240	0	0	31	1.4
240	0	0	THRU	264	0	0	42	1.9
264	0	0	THRU	288	0	0	27	1.2
288	0	0	THRU	312	0	0	18	0.8
312	0	0	THRU	336	0	0	23	1.0
336	0	0	THRU	360	0	0	14	0.6
360	0	0	THRU	384	0	0	19	0.8
384	0	0	THRU	408	0	0	49	2.2
408	0	0	THRU	432	0	0	30	1.3
432	0	0	THRU	456	0	0	29	1.3
456	0	0	THRU	480	0	0	15	0.7
480	0	0	THRU	504	0	0	13	0.6
504	0	0	THRU	528	0	0	10	0.4
528	0	0	THRU	552	0	0	0	0.0
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	0	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	0	0	THRU	696	0	0	0	0.0
696	0	0	THRU	720	0	0	0	0.0
		MORE	THAN	720	0	0	0	0.0

NUMBER DELAYED 2258

Figure 48 - STORAGE TIMES OF VANS (SIM. III)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 18MAY7

SUMMARY 2
NUMBER OF TRAINS (10 CARS PER TRAIN) AT STORAGE AREA

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 1347
MAXIMUM 65 (ON DAY 166 AT 8 0)
AVERAGE 13.64
MINIMUM 0 (ON DAY 0 AT 8 0, AND 203 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
0	36.7
1 THRU 5	19.7
6 THRU 10	12.9
11 THRU 15	4.2
16 THRU 20	2.3
21 THRU 25	0.9
26 THRU 30	2.9
31 THRU 35	3.3
36 THRU 40	1.4
41 THRU 45	1.9
46 THRU 50	1.7
51 THRU 55	4.3
56 THRU 60	4.3
61 THRU 65	3.1
66 THRU 70	0.0
71 THRU 75	0.0
76 THRU 80	0.0
81 THRU 85	0.0
86 THRU 90	0.0
91 THRU 95	0.0
96 THRU 100	0.0
OVER 100	0.0

Figure 49 - NUMBER OF TRAINS AT STORAGE AREA (SIM. III)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS

SUMMARY 27
STORAGE TIMES OF RAILCARS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 50524 HRS 26 MIN 50 SEC
MAXIMUM TIME 370 HRS 22 MIN 34 SEC (OCCURRED ON DAY 158. BEGINNING AT TIME 8 0)
AVERAGE TIME 75 HRS 4 MIN 24 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 0. BEGINNING AT TIME 8 0. AND 201 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	202	30.0
0	0	0	THRU	24	0	0	117	17.4
24	0	0	THRU	48	0	0	76	11.3
48	0	0	THRU	72	0	0	68	10.1
72	0	0	THRU	96	0	0	38	5.6
96	0	0	THRU	120	0	0	34	5.1
120	0	0	THRU	144	0	0	15	2.2
144	0	0	THRU	168	0	0	10	1.5
168	0	0	THRU	192	0	0	17	2.5
192	0	0	THRU	216	0	0	15	2.2
216	0	0	THRU	240	0	0	3	0.4
240	0	0	THRU	264	0	0	2	0.3
264	0	0	THRU	288	0	0	4	0.6
288	0	0	THRU	312	0	0	19	2.8
312	0	0	THRU	336	0	0	34	5.1
336	0	0	THRU	360	0	0	16	2.4
360	0	0	THRU	384	0	0	3	0.4
384	0	0	THRU	408	0	0	0	0.0
408	0	0	THRU	432	0	0	0	0.0
432	0	0	THRU	456	0	0	0	0.0
456	0	0	THRU	480	0	0	0	0.0
480	0	0	THRU	504	0	0	0	0.0
504	0	0	THRU	528	0	0	0	0.0
528	0	0	THRU	552	0	0	0	0.0
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	0	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	0	0	THRU	696	0	0	0	0.0
696	0	0	THRU	720	0	0	0	0.0
	MORE		THAN	720	0	0	0	0.0

TOTAL NUMBER 673

DELAY TIME

TOTAL DELAY 50524 HRS 26 MIN 50 SEC
MAXIMUM DELAY 370 HRS 22 MIN 34 SEC (OCCURRED ON DAY 158. BEGINNING AT TIME 8 0)
AVERAGE DELAY 107 HRS 16 MIN 14 SEC
MINIMUM DELAY 0 HRS 16 MIN 59 SEC (OCCURRED ON DAY 133. BEGINNING AT TIME 8 0)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	24	0	0	117	24.8
24	0	0	THRU	48	0	0	76	16.1
48	0	0	THRU	72	0	0	68	14.4
72	0	0	THRU	96	0	0	38	8.1
96	0	0	THRU	120	0	0	34	7.2
120	0	0	THRU	144	0	0	15	3.2
144	0	0	THRU	168	0	0	10	2.1
168	0	0	THRU	192	0	0	17	3.6
192	0	0	THRU	216	0	0	15	3.2
216	0	0	THRU	240	0	0	3	0.6
240	0	0	THRU	264	0	0	2	0.4
264	0	0	THRU	288	0	0	4	0.8
288	0	0	THRU	312	0	0	19	4.0
312	0	0	THRU	336	0	0	34	7.2
336	0	0	THRU	360	0	0	16	3.4
360	0	0	THRU	384	0	0	3	0.6
384	0	0	THRU	408	0	0	0	0.0
408	0	0	THRU	432	0	0	0	0.0
432	0	0	THRU	456	0	0	0	0.0
456	0	0	THRU	480	0	0	0	0.0
480	0	0	THRU	504	0	0	0	0.0
504	0	0	THRU	528	0	0	0	0.0
528	0	0	THRU	552	0	0	0	0.0
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	0	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	0	0	THRU	696	0	0	0	0.0
696	0	0	THRU	720	0	0	0	0.0
	MORE		THAN	720	0	0	0	0.0

NUMBER DELAYED 471

Figure 50 - STORAGE TIMES OF RAILCARS (SIM. III)

APPENDIX H

RESULTS OF SIMULATION RUN IV

Simulation run IV was run attempting to achieve 90 percent berth occupancy. The vessel arrivals were Poisson distributed with a mean interarrival time of 37 hours in order to generate about 117 vessels in the 180 day period.

Train arrivals were given a distribution of no trains arriving 25 percent of the days, one train 50 percent of the days, and two trains arriving 25 percent of the days. Arriving trains had 50 cars 40 percent of the time and 60 cars the remainder of the time. Therefore, on the average, 56 railcars arrived each day.

Truck arrivals were Poisson distributed with a mean interarrival time of 30 minutes during normal operations. When the number of vans in the storage area was less than 10, the mean interarrival time was 10 minutes and when the number of vans in the storage area was greater than 150, the mean interarrival time was 50 minutes. The average number of truck arrivals per eight hour receiving period was expected to be 16.8.

The results for simulation run IV are shown in the accompanying figures and are summarized as follows:

1) Occupancy rate was 5.99/6 = 99.8 percent.

2) Van cargo exported was (3132)(18) = 56376 long tons.

3) Rail cargo exported was (1026)(540) = 554040 long tons.

4) Total cargo exported was 554040 + 56376 = 610,416 long tons.

5) Number of vessels turned around was 127.

6) Percent of vessels delayed was 100 - 100.0 = 0.0 percent.

7) Average/maximum number of vans in the storage area was 55.2/150.

8) Average van storage time was about 72.2 hours.

9) Average/maximum number of railcars in the storage area was 105/520.

10) Average railcar storage time was about 42.5 hours.

NWS CONCORD EXPORT CAPABILITY   SIX MONTHS   19MAY77

MMARY 10
OCCUPANCY OF ALL BERTHS (TOTAL NUMBER OF SHIPS IN PORT)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

```
TOTAL NUMBER IN REPORT PERIOD        127
MAXIMUM       6 (ON DAY       0 AT   8 0,
                AND     127 OTHER TIMES)
AVERAGE       5,99
MINIMUM       0 (ON DAY       0 AT   0 0)
```

NUMBER			PERCENT OF REPORT PERIOD
0			0.2
1	THRU	1	0.0
2	THRU	2	0.0
3	THRU	3	0.0
4	THRU	4	0.0
5	THRU	5	0.0
6	THRU	6	99.8
	OVER	6	0.0

Figure 51 - OCCUPANCY OF ALL BERTHS (SIM. IV)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 19MA

SUMMARY 12
TOTAL TRUCK CARGO EXPORTED (UNITS OF 10 LONGTON)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 3132
MAXIMUM 211 (ON DAY 146 AT 1258)
AVERAGE 136.40
MINIMUM 0 (ON DAY 0 AT 0 0)

NUMBER	PERCENT OF REPORT PERIOD
0	0.2
1 THRU 100	11.1
101 THRU 200	87.8
201 THRU 300	0.9
301 THRU 400	0.0
401 THRU 500	0.0
501 THRU 600	0.0
601 THRU 700	0.0
701 THRU 800	0.0
801 THRU 900	0.0
901 THRU1000	0.0
OVER1000	0.0

Figure 52 - TOTAL TRUCK CARGO EXPORTED (SIM. IV)

SUMMARY 13
TOTAL RAIL CARGO EXPORTED (UNITS OF 540 LONGTONS)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 1026
MAXIMUM 45 (ON DAY 7 AT 2352, AND 1 OTHER TIMES)
AVERAGE 24.94
MINIMUM 0 (ON DAY 0 AT 0 0)

NUMBER	PERCENT OF REPORT PERIOD
0	0.6
1 THRU 100	99.4
101 THRU 200	0.0
201 THRU 300	0.0
301 THRU 400	0.0
401 THRU 500	0.0
501 THRU 600	0.0
601 THRU 700	0.0
701 THRU 800	0.0
801 THRU 900	0.0
901 THRU1000	0.0
OVER1000	0.0

Figure 53 - TOTAL RAIL CARGO EXPORTED (SIM. IV)

NWS CONCORD EXPORT CAPABILITY   SIX MONTHS   19MAY

SUMMARY 15
SHIP TIME AT ALL BERTHS (ALL SHIPS)

ELAPSED TIME (INCLUDING DELAYS)

```
TOTAL TIME     25159 HRS 40 MIN 12 SEC
MAXIMUM TIME     236 HRS 20 MIN 26 SEC (OCCURRED ON DAY    144,
                                        BEGINNING AT TIME  126)
AVERAGE TIME     198 HRS  6 MIN 27 SEC
MINIMUM TIME     106 HRS 24 MIN 16 SEC (OCCURRED ON DAY     17,
                                        BEGINNING AT TIME 1320)
```

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
96	0	0	OR LESS				0	0.0
96	0	0	THRU	108	0	0	2	1.6
108	0	0	THRU	120	0	0	6	4.7
120	0	0	THRU	132	0	0	0	0.0
132	0	0	THRU	144	0	0	0	0.0
144	0	0	THRU	156	0	0	2	1.6
156	0	0	THRU	168	0	0	2	1.6
168	0	0	THRU	180	0	0	4	3.1
180	0	0	THRU	192	0	0	10	7.9
192	0	0	THRU	204	0	0	39	30.7
204	0	0	THRU	216	0	0	38	29.9
216	0	0	THRU	228	0	0	20	15.7
228	0	0	THRU	240	0	0	4	3.1
240	0	0	THRU	252	0	0	0	0.0
252	0	0	THRU	264	0	0	0	0.0
264	0	0	THRU	276	0	0	0	0.0
276	0	0	THRU	288	0	0	0	0.0
		MORE	THAN	288	0	0	0	0.0
				TOTAL NUMBER			127	

Figure 54 - SHIP TIME AT ALL BERTHS (SIM. IV)

NWS CONCORD EXPORT CAPABILITY   SIX MONTHS

SHIP DELAY TIMES WAITING FOR BERTHS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 22853 HRS 9 MIN 44 SEC
MAXIMUM TIME 403 HRS 29 MIN 22 SEC (OCCURRED ON DAY 147. BEGINNING AT TIME 2214)
AVERAGE TIME 179 HRS 56 MIN 46 SEC
MINIMUM TIME 13 HRS 13 MIN 42 SEC (OCCURRED ON DAY 49. BEGINNING AT TIME 120)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	1	0	0	0	0.0
1	0	0	THRU	2	0	0	0	0.0
2	0	0	THRU	3	0	0	0	0.0
3	0	0	THRU	4	0	0	0	0.0
4	0	0	THRU	5	0	0	0	0.0
5	0	0	THRU	6	0	0	0	0.0
6	0	0	THRU	7	0	0	0	0.0
7	0	0	THRU	8	0	0	0	0.0
8	0	0	THRU	9	0	0	0	0.0
9	0	0	THRU	10	0	0	0	0.0
10	0	0	THRU	11	0	0	0	0.0
11	0	0	THRU	12	0	0	0	0.0
12	0	0	THRU	13	0	0	0	0.0
13	0	0	THRU	14	0	0	1	0.8
14	0	0	THRU	15	0	0	0	0.0
15	0	0	THRU	16	0	0	0	0.0
16	0	0	THRU	17	0	0	0	0.0
17	0	0	THRU	18	0	0	0	0.0
18	0	0	THRU	19	0	0	0	0.0
19	0	0	THRU	20	0	0	0	0.0
	MORE		THAN	20	0	0	126	99.2

TOTAL NUMBER 127

DELAY TIME

TOTAL DELAY 22853 HRS 9 MIN 44 SEC
MAXIMUM DELAY 403 HRS 29 MIN 22 SEC (OCCURRED ON DAY 147. BEGINNING AT TIME 2214)
AVERAGE DELAY 179 HRS 56 MIN 46 SEC
MINIMUM DELAY 13 HRS 13 MIN 42 SEC (OCCURRED ON DAY 49. BEGINNING AT TIME 120)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	2	0	0	0	0.0
2	0	0	THRU	4	0	0	0	0.0
4	0	0	THRU	6	0	0	0	0.0
6	0	0	THRU	8	0	0	0	0.0
8	0	0	THRU	10	0	0	0	0.0
10	0	0	THRU	12	0	0	0	0.0
12	0	0	THRU	14	0	0	1	0.8
14	0	0	THRU	16	0	0	0	0.0
16	0	0	THRU	18	0	0	0	0.0
18	0	0	THRU	20	0	0	0	0.0
20	0	0	THRU	22	0	0	0	0.0
22	0	0	THRU	24	0	0	0	0.0
24	0	0	THRU	26	0	0	0	0.0
26	0	0	THRU	28	0	0	0	0.0
28	0	0	THRU	30	0	0	0	0.0
30	0	0	THRU	32	0	0	1	0.8
32	0	0	THRU	34	0	0	0	0.0
34	0	0	THRU	36	0	0	0	0.0
36	0	0	THRU	38	0	0	0	0.0
38	0	0	THRU	40	0	0	0	0.0
40	0	0	THRU	42	0	0	1	0.8
42	0	0	THRU	44	0	0	1	0.8
44	0	0	THRU	46	0	0	0	0.0
46	0	0	THRU	48	0	0	0	0.0
	MORE		THAN	48	0	0	123	96.9

NUMBER DELAYED . 127

Figure 55 - SHIP DELAY TIMES (SIM. IV)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS

SUMMARY 1

NUMBER OF VANS IN STORAGE AREA

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 6569
MAXIMUM 150 (ON DAY 0 AT 8 0)
AVERAGE 55.23
MINIMUM 0 (ON DAY 0 AT 8 0, AND 103 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
0	2.0
1 THRU 25	22.6
26 THRU 50	22.1
51 THRU 75	24.2
76 THRU 100	19.3
101 THRU 125	7.6
126 THRU 150	2.1
151 THRU 175	0.0
176 THRU 200	0.0
201 THRU 225	0.0
226 THRU 250	0.0
251 THRU 275	0.0
276 THRU 300	0.0
301 THRU 325	0.0
326 THRU 350	0.0
351 THRU 375	0.0
376 THRU 400	0.0
OVER 400	0.0

Figure 56 - NUMBER OF VANS IN STORAGE AREAS (SIM. IV)

NWS CONCORD EXPERT CAPABILITY SIX MONTHS

SUMMARY 2c
STORAGE TIMES OF VANS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 237134 HRS 31 MIN 53 SEC
MAXIMUM TIME 194 HRS 34 MIN 52 SEC (OCCURRED ON DAY 9, BEGINNING AT TIME 1319)
AVERAGE TIME 72 HRS 12 MIN 33 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 9, BEGINNING AT TIME 8 0, AND 35 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	36	1.1
0	0	0	THRU	24	0	0	743	22.6
24	0	0	THRU	48	0	0	435	13.2
48	0	0	THRU	72	0	0	379	11.5
72	0	0	THRU	96	0	0	573	17.4
96	0	0	THRU	120	0	0	521	15.9
120	0	0	THRU	144	0	0	352	10.7
144	0	0	THRU	168	0	0	155	4.7
168	0	0	THRU	192	0	0	76	2.3
192	0	0	THRU	216	0	0	14	0.4
216	0	0	THRU	240	0	0	0	0.0
240	0	0	THRU	264	0	0	0	0.0
264	0	0	THRU	288	0	0	0	0.0
288	0	0	THRU	312	0	0	0	0.0
312	0	0	THRU	336	0	0	0	0.0
336	0	0	THRU	360	0	0	0	0.0
360	0	0	THRU	384	0	0	0	0.0
384	0	0	THRU	408	0	0	0	0.0
408	0	0	THRU	432	0	0	0	0.0
432	0	0	THRU	456	0	0	0	0.0
456	0	0	THRU	480	0	0	0	0.0
480	0	0	THRU	504	0	0	0	0.0
504	0	0	THRU	528	0	0	0	0.0
528	0	0	THRU	552	0	0	0	0.0
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	0	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	0	0	THRU	696	0	0	0	0.0
696	0	0	THRU	720	0	0	0	0.0
		MORE	THAN	720	0	0	0	0.0

TOTAL NUMBER 3284

DELAY TIME

TOTAL DELAY 237134 HRS 31 MIN 53 SEC
MAXIMUM DELAY 194 HRS 34 MIN 52 SEC (OCCURRED ON DAY 9, BEGINNING AT TIME 1319)
AVERAGE DELAY 73 HRS 0 MIN 34 SEC
MINIMUM DELAY 0 HRS 0 MIN 17 SEC (OCCURRED ON DAY 142, BEGINNING AT TIME 9 6)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	24	0	0	743	22.9
24	0	0	THRU	48	0	0	435	13.4
48	0	0	THRU	72	0	0	379	11.7
72	0	0	THRU	96	0	0	573	17.6
96	0	0	THRU	120	0	0	521	16.0
120	0	0	THRU	144	0	0	352	10.8
144	0	0	THRU	168	0	0	155	4.8
168	0	0	THRU	192	0	0	76	2.3
192	0	0	THRU	216	0	0	14	0.4
216	0	0	THRU	240	0	0	0	0.0
240	0	0	THRU	264	0	0	0	0.0
264	0	0	THRU	288	0	0	0	0.0
288	0	0	THRU	312	0	0	0	0.0
312	0	0	THRU	336	0	0	0	0.0
336	0	0	THRU	360	0	0	0	0.0
360	0	0	THRU	384	0	0	0	0.0
384	0	0	THRU	408	0	0	0	0.0
408	0	0	THRU	432	0	0	0	0.0
432	0	0	THRU	456	0	0	0	0.0
456	0	0	THRU	480	0	0	0	0.0
480	0	0	THRU	504	0	0	0	0.0
504	0	0	THRU	528	0	0	0	0.0
528	0	0	THRU	552	0	0	0	0.0
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	0	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	0	0	THRU	696	0	0	0	0.0
696	0	0	THRU	720	0	0	0	0.0
		MORE	THAN	720	0	0	0	0.0

NUMBER DELAYED 3248

Figure 57 - STORAGE TIMES OF VANS (SIM. IV)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 19MAY77

SUMMARY 2
NUMBER OF TRAINS (10 CARS PER TRAIN) AT STORAGE AREA

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 2128
MAXIMUM 53 (ON DAY 0 AT 8 0)
AVERAGE 10.43
MINIMUM 0 (ON DAY 0 AT 8 0,
AND 187 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
0	30.6
1 THRU 5	15.6
6 THRU 10	13.5
11 THRU 15	10.8
16 THRU 20	10.1
21 THRU 25	6.9
26 THRU 30	4.7
31 THRU 35	3.3
36 THRU 40	2.7
41 THRU 45	0.8
46 THRU 50	0.6
51 THRU 55	0.0
56 THRU 60	0.0
61 THRU 65	0.0
66 THRU 70	0.0
71 THRU 75	0.0
76 THRU 80	0.0
81 THRU 85	0.0
86 THRU 90	0.0
91 THRU 95	0.0
96 THRU 100	0.0
OVER 100	0.0

Figure 58 - NUMBER OF TRAINS AT STORAGE AREA (SIM. IV)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS

SUMMARY 27
STORAGE TIMES OF RAILCARS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 45297 HRS 50 MIN 16 SEC
MAXIMUM TIME 218 HRS 56 MIN 57 SEC (OCCURRED ON DAY 0. BEGINNING AT TIME 8 0)

AVERAGE TIME 42 HRS 34 MIN 23 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 0. BEGINNING AT TIME 8 0. AND 253 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	254	23.9
0	0	0	THRU	24	0	0	224	21.1
24	0	0	THRU	48	0	0	187	17.6
48	0	0	THRU	72	0	0	158	14.8
72	0	0	THRU	96	0	0	114	10.7
96	0	0	THRU	120	0	0	61	5.7
120	0	0	THRU	144	0	0	37	3.5
144	0	0	THRU	168	0	0	13	1.2
168	0	0	THRU	192	0	0	9	0.8
192	0	0	THRU	216	0	0	5	0.5
216	0	0	THRU	240	0	0	2	0.2
240	0	0	THRU	264	0	0	0	0.0
264	0	0	THRU	288	0	0	0	0.0
288	0	0	THRU	312	0	0	0	0.0
312	0	0	THRU	336	0	0	0	0.0
336	0	0	THRU	360	0	0	0	0.0
360	0	0	THRU	384	0	0	0	0.0
384	0	0	THRU	408	0	0	0	0.0
408	0	0	THRU	432	0	0	0	0.0
432	0	0	THRU	456	0	0	0	0.0
456	0	0	THRU	480	0	0	0	0.0
480	0	0	THRU	504	0	0	0	0.0
504	0	0	THRU	528	0	0	0	0.0
528	0	0	THRU	552	0	0	0	0.0
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	0	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	0	0	THRU	696	0	0	0	0.0
696	0	0	THRU	720	0	0	0	0.0
	MORE		THAN	720	0	0	0	0.0

TOTAL NUMBER 1064

DELAY TIME

TOTAL DELAY 45297 HRS 50 MIN 16 SEC
MAXIMUM DELAY 218 HRS 56 MIN 57 SEC (OCCURRED ON DAY 0. BEGINNING AT TIME 8 0)

AVERAGE DELAY 55 HRS 55 MIN 24 SEC
MINIMUM DELAY 0 HRS 8 MIN 41 SEC (OCCURRED ON DAY 93. BEGINNING AT TIME 8 0)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	24	0	0	224	27.7
24	0	0	THRU	48	0	0	187	23.1
48	0	0	THRU	72	0	0	158	19.5
72	0	0	THRU	96	0	0	114	14.1
96	0	0	THRU	120	0	0	61	7.5
120	0	0	THRU	144	0	0	37	4.6
144	0	0	THRU	168	0	0	13	1.6
168	0	0	THRU	192	0	0	9	1.1
192	0	0	THRU	216	0	0	5	0.6
216	0	0	THRU	240	0	0	2	0.2
240	0	0	THRU	264	0	0	0	0.0
264	0	0	THRU	288	0	0	0	0.0
288	0	0	THRU	312	0	0	0	0.0
312	0	0	THRU	336	0	0	0	0.0
336	0	0	THRU	360	0	0	0	0.0
360	0	0	THRU	384	0	0	0	0.0
384	0	0	THRU	408	0	0	0	0.0
408	0	0	THRU	432	0	0	0	0.0
432	0	0	THRU	456	0	0	0	0.0
456	0	0	THRU	480	0	0	0	0.0
480	0	0	THRU	504	0	0	0	0.0
504	0	0	THRU	528	0	0	0	0.0
528	0	0	THRU	552	0	0	0	0.0
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	0	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	0	0	THRU	695	0	0	0	0.0
695	0	0	THRU	720	0	0	0	0.0
	MORE		THAN	720	0	0	0	0.0

NUMBER DELAYED 810

Figure 59 - STORAGE TIMES OF RAILCARS (SIM. IV)

APPENDIX I

RESULTS OF SIMULATION RUN V

Simulation run V was run attempting to achieve 80 percent berth occupancy. The vessel arrivals were Poisson distributed with a mean interarrival time of 42 hours in order to generate about 104 vessels in the 180 day period.

Train arrivals were given a distribution of no trains arriving 25 percent of the days, one train 50 percent of the days, and two trains arriving 25 percent of the days. Arriving trains had 50 cars 100 percent of the time. Therefore, on the average, 50 railcars arrived each day.

Truck arrivals were Poisson distributed with a mean interarrival time of 33 minutes during normal operations. When the number of vans in the storage area was less than 10, the mean interarrival time was 13 minutes and when the number of vans in the storage area was greater than 150, the mean interarrival time was 53 minutes. The average number of truck arrivals per eight hour receiving period was expected to be 14.5.

The results for simulation run V are shown in the accompanying figures and are summarized as follows:

1) Occupancy rate was 4.65/6 = 77.5 percent.

2) Van cargo exported was (2496)(18) = 44928 long tons.

3) Rail cargo exported was (840)(540) = 453600 long tons.

4) Total cargo exported was 453600 + 44928 = 498,528

long tons.

5) Number of vessels turned around was 97.

6) Percent of vessels delayed was 100 - 44.3 = 55.7 percent.

7) Average/maximum number of vans in the storage area was 94.4/196.

8) Average van storage time was about 153.9 hours.

9) Average/maximum number of railcars in the storage area was 900/1530.

10) Average railcar storage time was about 404.9 hours.

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 20MAY77

MARY 10

OCCUPANCY OF ALL BERTHS (TOTAL NUMBER OF SHIPS IN PORT)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

```
TOTAL NUMBER IN REPORT PERIOD        97
MAXIMUM       6 (ON DAY        0 AT   8 0,
                AND       65 OTHER TIMES)
AVERAGE       4.65
MINIMUM       0 (ON DAY        0 AT   0 0)
```

NUMBER	PERCENT OF REPORT PERIOD
0	0.2
1 THRU 1	1.9
2 THRU 2	12.0
3 THRU 3	16.8
4 THRU 4	7.6
5 THRU 5	10.7
6 THRU 6	50.9
OVER 6	0.0

Figure 60 - OCCUPANCY OF ALL BERTHS (SIM. V)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 20MAY

SUMMARY 12

TOTAL TRUCK CARGO EXPORTED (UNITS OF 18 LONGTON)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 2496

MAXIMUM 205 (ON DAY 26 AT 16 9)

AVERAGE 108.64

MINIMUM 0 (ON DAY 0 AT 0 0)

NUMBER	PERCENT OF REPORT PERIOD
0	0.2
1 THRU 100	42.7
101 THRU 200	57.0
201 THRU 300	0.1
301 THRU 400	0.0
401 THRU 500	0.0
501 THRU 600	0.0
601 THRU 700	0.0
701 THRU 800	0.0
801 THRU 900	0.0
901 THRU1000	0.0
OVER1000	0.0

Figure 61 - TOTAL TRUCK CARGO EXPORTED (SIM. V)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 20MAY77

SUMMARY 13
TOTAL RAIL CARGO EXPORTED (UNITS OF 540 LONGTONS)

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 840
MAXIMUM 47 (ON DAY 23 AT 1227)
AVERAGE 21.67
MINIMUM 0 (ON DAY 0 AT 0 0)

NUMBER	PERCENT OF REPORT PERIOD
0	0.6
1 THRU 100	99.4
101 THRU 200	0.0
201 THRU 300	0.0
301 THRU 400	0.0
401 THRU 500	0.0
501 THRU 600	0.0
601 THRU 700	0.0
701 THRU 800	0.0
801 THRU 900	0.0
901 THRU1000	0.0
OVER1000	0.0

Figure 62 - TOTAL RAIL CARGO EXPORTED (SIM. V)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 20MAY77

SUMMARY 15
SHIP TIME AT ALL BERTHS (ALL SHIPS)

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 19522 HRS 26 MIN 50 SEC
MAXIMUM TIME 237 HRS 58 MIN 11 SEC (OCCURRED ON DAY 17, BEGINNING AT TIME 7 9)
AVERAGE TIME 201 HRS 15 MIN 44 SEC
MINIMUM TIME 108 HRS 44 MIN 27 SEC (OCCURRED ON DAY 160, BEGINNING AT TIME 610)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
96	0	0	OR LESS				0	0.0
96	0	0	THRU	108	0	0	0	0.0
108	0	0	THRU	120	0	0	5	5.2
120	0	0	THRU	132	0	0	0	0.0
132	0	0	THRU	144	0	0	0	0.0
144	0	0	THRU	156	0	0	1	1.0
156	0	0	THRU	168	0	0	0	0.0
168	0	0	THRU	180	0	0	4	4.1
180	0	0	THRU	192	0	0	9	9.3
192	0	0	THRU	204	0	0	27	27.8
204	0	0	THRU	216	0	0	28	28.9
216	0	0	THRU	228	0	0	21	21.6
228	0	0	THRU	240	0	0	2	2.1
240	0	0	THRU	252	0	0	0	0.0
252	0	0	THRU	264	0	0	0	0.0
264	0	0	THRU	276	0	0	0	0.0
276	0	0	THRU	288	0	0	0	0.0
		MORE	THAN	288	0	0	0	0.0
				TOTAL NUMBER			97	

Figure 63 - SHIP TIME AT ALL BERTHS (SIM. V)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS

SUMMARY 14
SHIP DELAY TIMES WAITING FOR BERTHS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 4109 HRS 1 MIN 7 SEC
MAXIMUM TIME 188 HRS 51 MIN 32 SEC (OCCURRED ON DAY 0. BEGINNING AT TIME 1125)
AVERAGE TIME 42 HRS 21 MIN 40 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 9. BEGINNING AT TIME 1323. AND 42 OTHER TIMES)

HRS MIN SEC		HRS MIN SEC	FREQUENCY	PER CENT
		0 0 0	43	44.3
0 0 0	THRU	1 0 0	0	0.0
1 0 0	THRU	2 0 0	0	0.0
2 0 0	THRU	3 0 0	1	1.0
3 0 0	THRU	4 0 0	1	1.0
4 0 0	THRU	5 0 0	0	0.0
5 0 0	THRU	6 0 0	2	2.1
6 0 0	THRU	7 0 0	0	0.0
7 0 0	THRU	8 0 0	0	0.0
8 0 0	THRU	9 0 0	0	0.0
9 0 0	THRU	10 0 0	0	0.0
10 0 0	THRU	11 0 0	0	0.0
11 0 0	THRU	12 0 0	0	0.0
12 0 0	THRU	13 0 0	1	1.0
13 0 0	THRU	14 0 0	0	0.0
14 0 0	THRU	15 0 0	1	1.0
15 0 0	THRU	16 0 0	0	0.0
16 0 0	THRU	17 0 0	0	0.0
17 0 0	THRU	18 0 0	0	0.0
18 0 0	THRU	19 0 0	1	1.0
19 0 0	THRU	20 0 0	0	0.0
	MORE THAN	20 0 0	47	48.5

TOTAL NUMBER 97

DELAY TIME

TOTAL DELAY 4109 HRS 1 MIN 7 SEC
MAXIMUM DELAY 188 HRS 51 MIN 32 SEC (OCCURRED ON DAY 0. BEGINNING AT TIME 1125)
AVERAGE DELAY 76 HRS 5 MIN 35 SEC
MINIMUM DELAY 2 HRS 40 MIN 48 SEC (OCCURRED ON DAY 24. BEGINNING AT TIME 2050)

HRS MIN SEC		HRS MIN SEC	FREQUENCY	PER CENT
		0 0 0	0	0.0
0 0 0	THRU	2 0 0	0	0.0
2 0 0	THRU	4 0 0	2	3.7
4 0 0	THRU	6 0 0	2	3.7
6 0 0	THRU	8 0 0	0	0.0
8 0 0	THRU	10 0 0	0	0.0
10 0 0	THRU	12 0 0	0	0.0
12 0 0	THRU	14 0 0	1	1.9
14 0 0	THRU	16 0 0	1	1.9
16 0 0	THRU	18 0 0	0	0.0
18 0 0	THRU	20 0 0	1	1.9
20 0 0	THRU	22 0 0	0	0.0
22 0 0	THRU	24 0 0	1	1.9
24 0 0	THRU	26 0 0	0	0.0
26 0 0	THRU	28 0 0	2	3.7
28 0 0	THRU	30 0 0	0	0.0
30 0 0	THRU	32 0 0	0	0.0
32 0 0	THRU	34 0 0	0	0.0
34 0 0	THRU	36 0 0	0	0.0
36 0 0	THRU	38 0 0	1	1.9
38 0 0	THRU	40 0 0	0	0.0
40 0 0	THRU	42 0 0	1	1.9
42 0 0	THRU	44 0 0	0	0.0
44 0 0	THRU	46 0 0	1	1.9
46 0 0	THRU	48 0 0	0	0.0
	MORE THAN	48 0 0	41	75.9

NUMBER DELAYED 54

Figure 64 - SHIP DELAY TIMES (SIM. V)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 20MAY77

SUMMARY 1

NUMBER OF VANS IN STORAGE AREA

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 5299
MAXIMUM 196 (ON DAY 104 AT 1559)
AVERAGE 94.42
MINIMUM 0 (ON DAY 0 AT 8 0,
AND 72 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
0	1.6
1 THRU 25	15.3
26 THRU 50	12.2
51 THRU 75	13.4
76 THRU 100	10.3
101 THRU 125	12.5
126 THRU 150	8.7
151 THRU 175	18.7
176 THRU 200	7.3
201 THRU 225	0.0
226 THRU 250	0.0
251 THRU 275	0.0
276 THRU 300	0.0
301 THRU 325	0.0
326 THRU 350	0.0
351 THRU 375	0.0
376 THRU 400	0.0
OVER 400	0.0

Figure 65 - NUMBER OF VANS IN STORAGE AREAS (SIM. V)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS

STORAGE TIMES OF VANS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 407741 HRS 9 MIN 23 SEC
MAXIMUM TIME 537 HRS 8 MIN 33 SEC (OCCURRED ON DAY 95. BEGINNING AT TIME 1458)

AVERAGE TIME 153 HRS 55 MIN 22 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 0. BEGINNING AT TIME 8 0. AND 25 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	26	1.0
0	0	0	THRU	24	0	0	459	17.3
24	0	0	THRU	48	0	0	310	11.7
48	0	0	THRU	72	0	0	246	9.3
72	C	0	THRU	96	0	0	150	5.7
96	0	0	THRU	120	0	0	165	6.2
120	0	0	THRU	144	0	0	153	5.8
144	0	0	THRU	168	0	0	142	5.4
168	0	0	THRU	192	0	C	136	5.1
192	C	0	THRU	216	0	0	151	5.7
216	0	0	THRU	240	0	0	69	2.6
240	0	0	THRU	264	0	0	57	2.2
264	C	0	THRU	288	0	0	65	2.5
288	0	0	THRU	312	0	0	68	2.6
312	0	0	THRU	336	0	0	82	3.1
336	0	0	THRU	360	0	0	46	1.7
360	C	0	THRU	384	0	0	88	3.3
384	0	0	THRU	408	0	0	47	1.8
408	C	0	THRU	432	0	0	48	1.8
432	C	C	THRU	456	0	0	34	1.3
456	C	0	THRU	480	0	0	58	2.2
480	0	0	THRU	504	0	0	30	1.1
504	C	0	THRU	528	0	0	16	0.6
528	C	0	THRU	552	0	0	3	0.1
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	C	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	C	0	THRU	696	0	0	0	0.0
696	0	0	THRU	720	0	0	0	0.0
	MORE		THAN	720	0	0	0	0.0

TOTAL NUMBER 2649

DELAY TIME

TOTAL DELAY 407741 HRS 9 MIN 23 SEC
MAXIMUM DELAY 537 HRS 8 MIN 33 SEC (OCCURRED ON DAY 95. BEGINNING AT TIME 1458)

AVERAGE DELAY 155 HRS 26 MIN 54 SEC
MINIMUM DELAY 0 HRS 9 MIN 1 SEC (OCCURRED ON DAY 19. BEGINNING AT TIME 9 3)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	C	0.0
0	0	0	THRU	24	0	0	459	17.5
24	0	0	THRU	48	0	0	310	11.8
48	0	0	THRU	72	0	0	246	9.4
72	0	0	THRU	96	0	0	150	5.7
96	0	0	THRU	120	0	0	165	6.3
120	0	0	THRU	144	0	0	153	5.8
144	0	0	THRU	168	0	0	142	5.4
168	0	0	THRU	192	0	0	136	5.2
192	0	0	THRU	216	0	0	151	5.8
216	0	0	THRU	240	0	0	69	2.6
240	0	0	THRU	264	0	0	57	2.2
264	0	0	THRU	288	0	0	65	2.5
288	0	0	THRU	312	0	0	68	2.6
312	0	0	THRU	336	0	0	82	3.1
336	0	0	THRU	360	0	0	46	1.8
360	0	0	THRU	384	0	0	88	3.4
384	0	0	THRU	408	0	0	47	1.8
408	0	0	THRU	432	0	0	48	1.8
432	0	0	THRU	456	0	0	34	1.3
456	0	0	THRU	480	0	C	58	2.2
480	0	0	THRU	504	0	0	30	1.1
504	0	0	THRU	528	0	0	16	0.6
528	0	0	THRU	552	0	0	3	0.1
552	0	0	THRU	576	0	0	0	0.0
576	0	0	THRU	600	0	0	0	0.0
600	0	0	THRU	624	0	0	0	0.0
624	0	0	THRU	648	0	0	0	0.0
648	0	0	THRU	672	0	0	0	0.0
672	0	0	THRU	696	0	0	0	0.0
696	0	0	THRU	720	0	0	0	0.0
	MORE		THAN	720	0	0	0	0.0

NUMBER DELAYED 2623

Figure 66 - STORAGE TIMES OF VANS (SIM. V)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS 20MAY77

SUMMARY 2
NUMBER OF TRAINS (10 CARS PER TRAIN) AT STORAGE AREA

TOTAL NUMBER IN SERVICE, DELAYED, OR IDLE

TOTAL NUMBER IN REPORT PERIOD 1747
MAXIMUM 153 (ON DAY 140 AT 8 0)
AVERAGE 90.00
MINIMUM 0 (ON DAY 0 AT 8 0,
AND 1 OTHER TIMES)

NUMBER	PERCENT OF REPORT PERIOD
0	0.0
1 THRU 5	0.0
6 THRU 10	0.0
11 THRU 15	0.0
16 THRU 20	0.0
21 THRU 25	0.2
26 THRU 30	1.5
31 THRU 35	6.6
36 THRU 40	6.7
41 THRU 45	6.0
46 THRU 50	3.0
51 THRU 55	2.5
56 THRU 60	3.0
61 THRU 65	2.8
66 THRU 70	2.7
71 THRU 75	4.4
76 THRU 80	2.1
81 THRU 85	3.1
86 THRU 90	5.7
91 THRU 95	5.4
96 THRU 100	1.1
OVER 100	43.2

Figure 67 - NUMBER OF TRAINS AT STORAGE AREA (SIM. V)

NWS CONCORD EXPORT CAPABILITY SIX MONTHS

SUMMARY 27
STORAGE TIMES OF RAILCARS

ELAPSED TIME (INCLUDING DELAYS)

TOTAL TIME 353485 HRS 41 MIN 15 SEC
MAXIMUM TIME 777 HRS 48 MIN 51 SEC (OCCURRED ON DAY 109, BEGINNING AT TIME 8 0)
AVERAGE TIME 404 HRS 54 MIN 32 SEC
MINIMUM TIME 0 HRS 0 MIN 0 SEC (OCCURRED ON DAY 0, BEGINNING AT TIME 8 0, AND 5 OTHER TIMES)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	6	0.7
0	0	0	THRU	24	0	0	5	0.6
24	0	0	THRU	48	0	0	5	0.6
48	0	0	THRU	72	0	0	5	0.6
72	0	0	THRU	96	0	0	7	0.8
96	0	0	THRU	120	0	0	15	1.7
120	0	0	THRU	144	0	0	48	5.5
144	0	0	THRU	168	0	0	73	8.4
168	0	0	THRU	192	0	0	64	7.3
192	0	0	THRU	216	0	0	67	7.7
216	0	0	THRU	240	0	0	30	3.4
240	0	0	THRU	264	0	0	13	1.5
264	0	0	THRU	288	0	0	3	0.3
288	0	0	THRU	312	0	0	2	0.2
312	0	0	THRU	336	0	0	5	0.6
336	0	0	THRU	360	0	0	38	4.4
360	0	0	THRU	384	0	0	60	6.9
384	0	0	THRU	408	0	0	28	3.2
408	0	0	THRU	432	0	0	3	0.3
432	0	0	THRU	456	0	0	3	0.3
456	0	0	THRU	480	0	0	5	0.6
480	0	0	THRU	504	0	0	22	2.5
504	0	0	THRU	528	0	0	53	6.1
528	0	0	THRU	552	0	0	14	1.6
552	0	0	THRU	576	0	0	18	2.1
576	0	0	THRU	600	0	0	23	2.6
600	0	0	THRU	624	0	0	25	2.9
624	0	0	THRU	648	0	0	66	7.6
648	0	0	THRU	672	0	0	52	6.0
672	0	0	THRU	696	0	0	42	4.8
696	0	0	THRU	720	0	0	26	3.0
		MORE	THAN	720	0	0	47	5.4

TOTAL NUMBER 873

DELAY TIME

TOTAL DELAY 353485 HRS 41 MIN 15 SEC
MAXIMUM DELAY 777 HRS 48 MIN 51 SEC (OCCURRED ON DAY 109, BEGINNING AT TIME 8 0)
AVERAGE DELAY 407 HRS 42 MIN 40, SEC
MINIMUM DELAY 17 HRS 53 MIN 9 SEC (OCCURRED ON DAY 0, BEGINNING AT TIME 8 0)

HRS	MIN	SEC		HRS	MIN	SEC	FREQUENCY	PER CENT
				0	0	0	0	0.0
0	0	0	THRU	24	0	0	5	0.6
24	0	0	THRU	48	0	0	5	0.6
48	0	0	THRU	72	0	0	5	0.6
72	0	0	THRU	96	0	0	7	0.8
96	0	0	THRU	120	0	0	15	1.7
120	0	0	THRU	144	0	0	48	5.5
144	0	0	THRU	168	0	0	73	8.4
168	0	0	THRU	192	0	0	64	7.4
192	0	0	THRU	216	0	0	67	7.7
216	0	0	THRU	240	0	0	30	3.5
240	0	0	THRU	264	0	0	13	1.5
264	0	0	THRU	288	0	0	3	0.3
288	0	0	THRU	312	0	0	2	0.2
312	0	0	THRU	336	0	0	5	0.6
336	0	0	THRU	360	0	0	38	4.4
360	0	0	THRU	384	0	0	60	6.9
384	0	0	THRU	408	0	0	28	3.2
408	0	0	THRU	432	0	0	3	0.3
432	0	0	THRU	456	0	0	3	0.3
456	0	0	THRU	480	0	0	5	0.6
480	0	0	THRU	504	0	0	22	2.5
504	0	0	THRU	528	0	0	53	6.1
528	0	0	THRU	552	0	0	14	1.6
552	0	0	THRU	576	0	0	18	2.1
576	0	0	THRU	600	0	0	23	2.7
600	0	0	THRU	624	0	0	25	2.9
624	0	0	THRU	648	0	0	66	7.6
648	0	0	THRU	672	0	0	52	6.0
672	0	0	THRU	696	0	0	42	4.8
696	0	0	THRU	720	0	0	26	3.0
		MORE	THAN	720	0	0	47	5.4

NUMBER DELAYED 867

Figure 68 - STORAGE TIMES OF RAILCARS (SIM. V)

APPENDIX J

VESSEL EXPORT TONNAGES IN CLASS GROUPINGS FOR JANUARY THROUGH JUNE 1968

This appendix is a representation of all vessels in each class, of the vessels that made complete turnarounds in the first six months of 1968, showing the relative distribution of vessel cargo tonnages within each class and the number of vessels in the class.

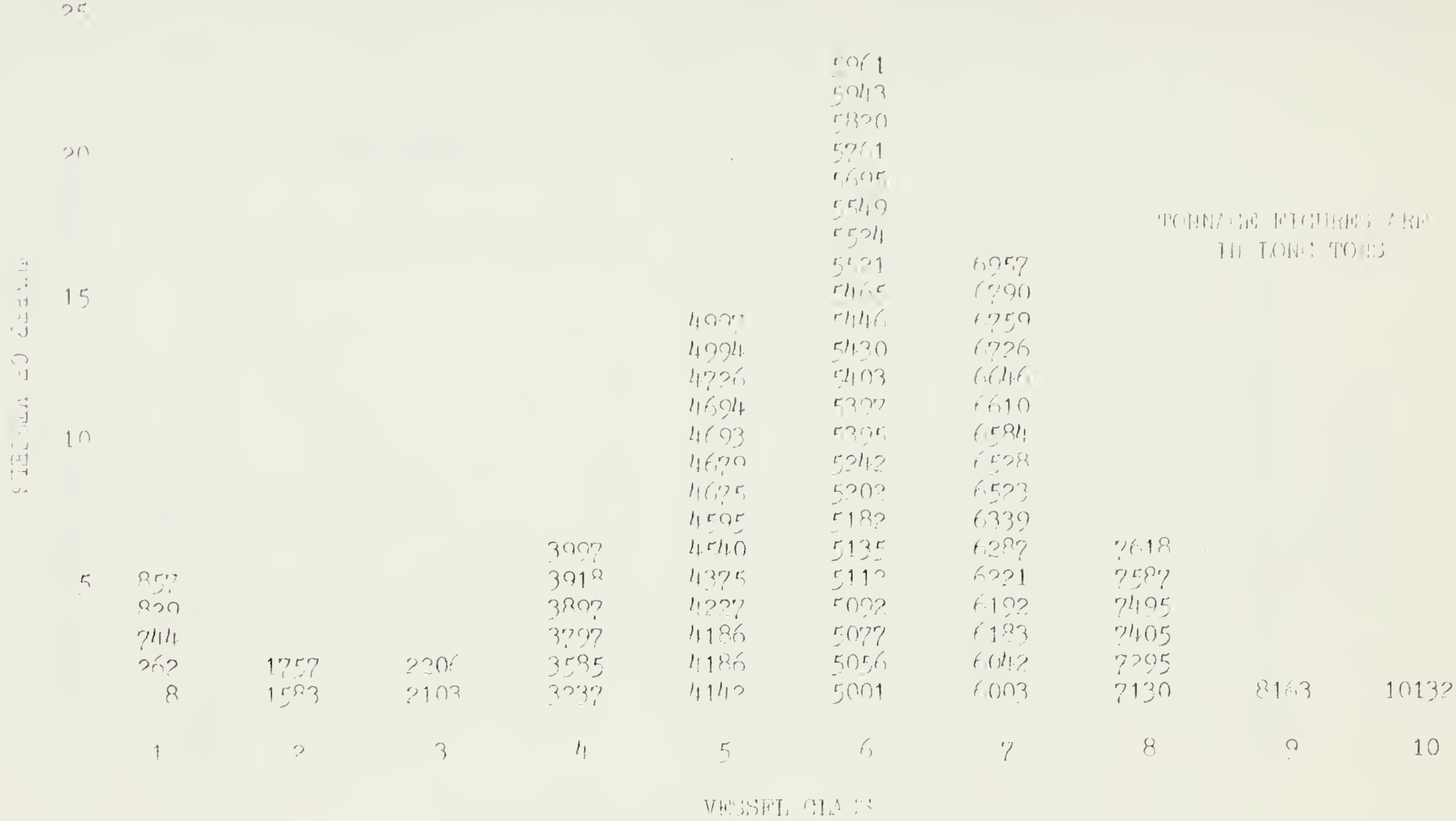

Figure 69 - VESSEL EXPORT TONNAGES IN CLASS GROUPINGS FOR JANUARY THROUGH JUNE 1968

APPENDIX K

THE TRIANGULAR DISTRIBUTION

The triangular distribution is a distribution made available to the users of TRANSIM. The upper and lower ranges of the event possibilities are defined to have zero probability. The only other significant point on the probability curve is at an arbitrary point between the upper and lower limits with an assigned probability. Connecting the three points forms a triangle, hence the name. The "curve" is just two connecting straight lines. The figure below gives an example of the triangular density function for the berth time distribution of a class 01 vessel used in this model.

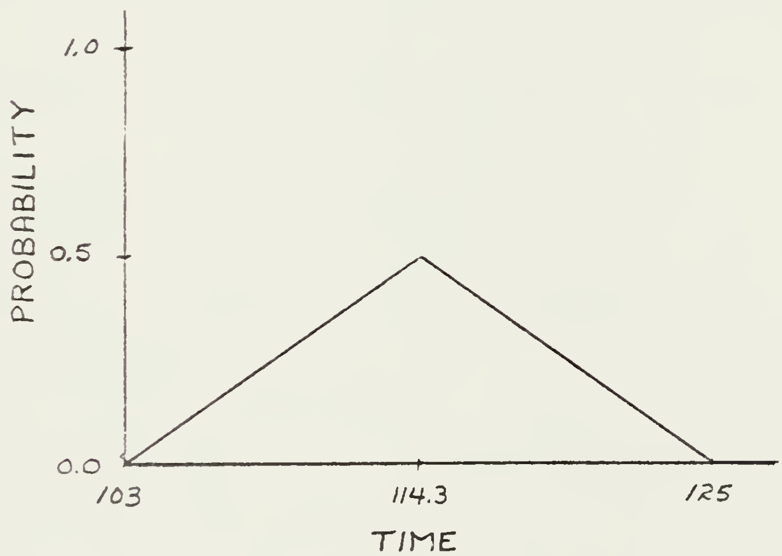

Figure 70 - A TRIANGULAR DISTRIBUTION

LIST OF REFERENCES

1. *Visitor Briefing, Naval Weapons Station*, Extracted from the Naval Ordinance Capability Catalog.

BIBLIOGRAPHY

1. Breiman, Leo, *Statistics, With a View Toward Applications*, Houghton Mifflin, 1973.

2. Cinlar, Erhan, *Introduction to Stochastic Processes*, Prentice-Hall, 1975.

3. Fishman, G. S., *Concepts and Methods in Discrete Event Digital Simulation*, Wiley, 1973.

4. Frank, H. and Frisch, I. T., *Communication, Transmission, and Transportation Networks*, Addison-Wesley, 1971.

5. Gass, S. I., *Linear Programming*, McGraw-Hill, 4th edition, 1975.

6. Hadley, G., *Linear Programming*, Addison-Wesley, 1962.

7. Larson, H. J., *Introduction to Probability Theory and Statistical Inference*, Wiley, 1969.

8. Moder, J. J. and Phillips, C. R., *Project Management with CPM and PERT*, Reinhold, 1964.

9. Taft, C. A., *Management of Physical Distribution and Transportation*, Irwin, 1972.

10. *TRANSIM IV General Purpose System Simulator, User's Manual*, School of Engineering and Applied Science, UCLA, 1971.

11. *Visitor Briefing, Naval Weapons Station*, Extracted from the Naval Ordnance Capability Catalog.

12. Whitehouse, G. E., _Systems Analysis and Design Using Network Techniques_, Prentice-Hall, 1973.

INITIAL DISTRIBUTION LIST

No. Copies

1. Defense Documentation Center — 2
   Cameron Station
   Alexandria, Virginia 22314

2. Library, Code 0142 — 2
   Naval Postgraduate School
   Monterey, California 93940

3. Department Chairman, Code 54 — 1
   Department of Administrative Science
   Naval Postgraduate School
   Monterey, California 93940

4. Command and General Staff College — 1
   ATTN: Educational Advisor
   Room 123, Bell Hall
   Fort Leavenworth, Kansas

5. LCDR. Robert W. Sagehorn, USN Code 54SN — 1
   Administrative Sciences Department
   Naval Postgraduate School
   Monterey, California 93940

6. LT. Don Bouchoux, USN Code 55BH — 1
   Operations Research Department
   Naval Postgraduate School
   Monterey, California 93940

7. CPT. David C. Fountain — 1
   LEA, New Cumberland Army Depot
   New Cumberland, Pennsylvania 17070

Thesis 171622
F6635 Fountain
c.1 Naval Weapons Station,
Concord export capability: a simulation model.